ALASKA NATIVE LANGUAGE CENTER RESEARCH PAPERS

Number 1

PROTO-ATHABASKAN VERB STEM VARIATION
PART ONE: PHONOLOGY

by
Jeff Leer

1979

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PART ONE: PHONOLOGY[1]

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1. I wish to express my appreciation to Michael Krauss for his continued interest and many hours of productive discussion with me, which have contributed much to the ideas presented here and helped clarify the exposition of the theory, for his careful readings of this paper, and most importantly, for stimulating me to write this paper.

I would like to thank James Kari, who has likewise urged me on in writing this paper and has read it with me, and has applied and tested many of the ideas presented here with Alaskan Athabaskan languages (Ahtna, Tanaina, Ingalik) as well as having done most of the research involved in bringing to light the verbal systems of these languages. His forthcoming paper on Ahtna verb theme categories gives a synchronic description which illustrates and expands on the theory outlined here within the limits of the Ahtna verb system.

Eliza Jones is working on a similar study of Koyukon. My thanks also to her and to Katherine Peter for their constant help, as well as to Jane McGary, who typed the paper and compiled the reference list. Without all their help, this paper might never have appeared.

An earlier working draft of this paper (Leer 1975) has been circulated to some extent. This draft dealt mainly with the behavior of obstruent-closed roots. The theory of the origin of ablaut, however, was not developed until recently.

Those who have read the earlier draft should note in particular that the reconstructions of *CV·T' and *CV’T' roots have been reversed; the earlier *’a’tš' is now reconstructed as *’a·tš', and the earlier *’a·tł' as *’a’tł'. The reason for the reversal is based largely on work that has since been done on the analysis of noun stems. We may note, for example, that stems like PA *łu·q'ə 'fish' were probably originally compound nouns. These do not develop constriction in PA. For this and other reasons it seemed more feasible to conclude that PPA *CV·T' > PA *CV̊·T' and not *CV̇·T' (see 2.3.2 and 2.3.5).

0. Introduction

This is the first half of a paper on Athabaskan verb stem variation; this first half deals with the phonological aspects of verb stem variation, and specifically the formation of variants for both obstruent-closed and non-obstruent-closed stems. The second half of this paper, which will deal with verb stem morphology, is yet to be written. Section 1 defines the system of PA reconstruction followed in the paper, and distinguishes between two stages of prehistoric Athabaskan, Proto-Athabaskan (PA) and Pre-Proto-Athabaskan (PPA). In Section 1.3 some of the phonological changes involved in the transition from PPA to PA are discussed. After a survey of the previous study on Athabaskan verb stem variation in 2.1, the most important phonological changes with regard to the subject of this paper are discussed in Section 2: spirantization and the development of constriction, nasalization and ablaut. In effect, the listing of these historical processes is tantamount to a listing of morphophonemic rules which operate in PA verb stem variation.

Obstruent-closed stem variation is analyzed in Section 3 (but invariable and irregular roots are reserved for section 5). Variable obstruent-closed stem variation is accounted for by three productive processes: lengthening, suffixation of the perfective suffix *-Ỹ, and obstruent suffixation. These stem variants result from the operation of the rules introduced in section 2. The processes of spirantization and constriction are further explored by inductive analysis of obstruent-closed stem variants. In section 3.5, examples of variable obstruent-closed roots are given, with data from specific languages.[2]

Section 4 deals with stem variation in variable non-obstruent-closed roots. Here the mechanics of stem variation is more transparent, but there are more possible stem variants. These are grouped according to how they correspond with obstruent-closed stem variants. Section 4.7 is a short speculative comparison of PPA, Eyak, and Tlingit open stem variation.

In section 5.1, stem variation for invariable roots and other irregular roots is surveyed, and the status of these irregular roots in PPA is discussed. The phonology of non-obstruent-closed and obstruent-closed roots is compared in Section 5.2, and in section 5.3 the morphological aspect of Athabaskan verb stem variation is previewed.

Finally, an appendix of phonological rules covering the transition from PPA to PA has been added for reference purposes.

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2. The principal sources of data used in this paper are the following:

Navajo (Nav.): Hoijer 1974, Young and Morgan 1943
Sarcee (Sar.): Li 1930a
Chipewyan (Chip.): Li 1933
Carrier (Car.): Morice 1932
Kutchin (Kut.): Sapir 1925, Peter, Leer and McGary in prep.
Koyukon (Koy.): Jetté and Jones in prep.
Ahtna (Aht.): Kari 1978a
Hupa: Golla 1966

Also occasionally cited are forms from Tanana (Krauss 1974), Ingalik (Kari 1978c), Mattole (Li 1930b), Eyak (Krauss 1970), and Tlingit (Naish and Story 1973, Leer n.d.).

The orthographies used in the source materials have been standardized or otherwise modified in some cases; in the case of Carrier, the material has been radically retranscribed since Morice's orthography, although fairly accurate, is too far removed from that used in other Athabaskan, and not always phonemic. In some cases I have also indicated possible corrections in transcription by writing the expected form in brackets after the cited form, especially in the case of Sarcee stem tones (see note 13).

1. Comparative Athabaskan phonology

1.1 Outline of Proto-Athabaskan stem phonology

A root is here defined as an underlying form, from which through regular phonological modification of the vowel nucleus and/or suffixation, the stems of a given stem set or group of stem sets may be derived. A stem is thus defined as root ± modification ± suffix. Throughout this paper I distinguish between Proto-Athabaskan (PA), by which I refer to the Athabaskan language immediately prior to its separation into different languages, and Pre-Proto-Athabaskan (PPA), the more hypothetically reconstructed stage of the language previous to certain important phonological and structural changes, which more closely resembled Eyak and Tlingit. Therefore, in positing PA forms, I have tried to stay within the bounds of the data at hand; inferences as to earlier forms of a stem are labeled PPA forms. The reader should note that Krauss's reconstruction of PA (Krauss 1964) corresponds roughly to the stage here referred to as PPA.

Table 1. Proto-Athabaskan Phoneme Inventory

Obstruents (X)

	alveolar	affricate series				front velar	back velar (uvular)	glottal
	(D)	(DL)	(DZ)	(DŽ)	(DŽ^w)	(G̑)	(Ġ)	(H)
plain stops (D)	d	dl	dz	dž	dž^w	g̑	G	?
aspirated stops (T)	t	tł	ts	tš	tš^w	k̯	q	
glottalized stops (T')	t'	tł'	ts'	tš'	tš'^{w}	k̯'	q'	
voiceless fricatives (S)		ł	s	š	š^w	x̯	x̣	h
voiced fricatives (Z)		l	z	ž	ž^w	ɣ̑	ɣ̇	

Sonorants (R) (see Krauss and Leer 1976):

	front		back
oral	y	-	w
nasal (N)	ỹ	n	w̃

Vowels (V)

full (V)	i		e[3]	a[3]	u
reduced (v)		ə		ɑ	ʊ

---

[3] *e phonetically [æ], *a phonetically [ɔ].

Affricates are here classified as stops. Syllable-finally, plain and aspirated stops did not contrast; here they are written with the symbol for aspirated stops and referred to as non-glottalized final obstruents.[4] Morphologically, however, they are best considered plain stops, since when a vocalic suffix is added to a stem ending in a non-glottalized stop, this stop becomes part of the following syllable and appears as a plain stop. Thus stem-finally there is only a two-way contrast between final obstruents, plain (X¯) and glottalized (X'). Such is the case in Eyak, Tlingit, and most Athabaskan languages which retain syllable-final stops.

Full vowels are long except immediately preceding glottal stop or the enclitic *+he· (see 4.5). In rule form this may be stated as V· > V/___ H̲.[5] Reduced vowels occur in stem syllables only when they precede a consonant other than glottal stop. Vowels in obstruent-closed syllables may be modified by nasalization (*V̲, see 1.2.5) and/or by constriction (*V̲̉, see 1.2.4). Note that constriction is not distinguishable before an overt stem-final glottal stop; thus *CV' = *CV̉', and *CV̲R' = *CV̲̉R'. Likewise, nasalization is not distinguishable before medial or overt final nasals; thus, *CV̲N(’) = *CV̨̲N(’).

---

[4] In some of the more recent scientific orthographies (Naish and Story, Krauss, Golla), final non-glottalized stops are written as plain stops. To do so in reconstructing PA may create a problem with citation of data from languages such as Tanacross and Ingalik which have light:heavy final pairs: where the stem ends in an obstruent, the light final is voiceless and the heavy final is voiced. The practice of writing final non-glottalized stops as voiceless stops is also followed in writing forms from my data base, except in Navajo where final -d is standard, and Hupa for which Golla wrote his stem list morphophonemically.

[5] It is not strictly necessary to mark vowel length in PA, but since vowel length is phonemic in Tlingit, Eyak and PPA forms, it is easy to confuse Tlingit, Eyak, and PPA short *V with PA full *V, unless the length is marked in PA.

Canonical stem syllable types are *CV˙, *CV’, *CvR, *CvR’X, *CV˙R, *CV˙R’, *CvX(X), *CV˙X(X), *CvRvX(X), *CvZvX(X). CV˙ syllables are here called open syllables. The types *CvRvX(X) and *CvZvX(X), here called broken stems after Krauss (p.c.), are attested in a few common noun stems, e.g. PA dənəx̯̲ 'crowberry', t'əɣ̇əs 'cottonwood', tł'əɣ̇əš^{w} 'leech' (cf. Krauss 1964:127). Also, a number of interesting broken verb stems are found in some Alaskan languages, especially Ingalik (see 5.1.3).

1.2 Reconstruction of PA stems

Following is a synopsis of the basis on which PA reconstructions are made in this paper (see note 2). This summary is not intended to be complete, but to provide the reader with a means for interpreting the data. Note that the symbols used in individual languages are not necessarily phonetic symbols; for example, the symbols /e/ and /a/ may both be used to represent a vowel approximating /æ/; likewise /a/ and /o/ for /ɔ/.

1.2.1 Obstruents

Reconstruction of obstruents is based on the following correspondences among the languages represented in this sketch:

PA D̲ > D̲ in all languages (Chipewyan final r = d)

> D̲ (~D̲Ž̲/__i, unless i < *a) in Kutchin

PA D̲L̲ > D̲L̲ in all languages

PA D̲Z̲ > D̲Z̲ in Nav., Sar., Aht., Tanaina, Hupa, Mattole (*z > Hupa and Mattole s)

D̲Z̯̲ or D̲Z̲ in Carrier (possibly due to inconsistencies in Morice's transcription)

Dð in Chip., Tanana, Ingalik

Dð (~ G/__i) in Kut.

PA DŽ > DŽ in Nav., Tanaina, Hupa, Mattole (*š, *ž > Hupa W, Mattole x)

DZ in Sar., Chip., Car., Kut., Tanana, Koy., Ing., Aht. (final *š, *ž > Tanana and Ing. š^{r}, ž^{r})

PA DŽ^{w} > DŽ^{r} in Kut., Tanana, Ing.

merges with DŽ elsewhere

PA Ĝ > Ĝ in Hupa (*x̭ > Hupa W)

G in Koy., Tanaina, Aht., (final *x̭ Tanaina š or x̭,[6] Aht. s)

G, DŽ in Ing. (conditioning not fully determined)

DŽ in Sar., Chip., Car., Tanana, Mattole (final *x̭ > Nav. and Sar. h, Chip. and Car. ih, Tanana x̭, Mattole x; final *γ̂ > Nav. i, Sar. y, Chip. and Car. i; final *k̭(') > Sar. and Chip. y, Car. and Tanana k, but Mattole d (?))

DŽ (~ DZ̭/__i) in Kut. (final *x̭ > i(h); final *k̭(') > k)

DZ in Nav. (final *x̭ > h; final *γ̂ > i; final *k̭(') > ')

(Note: for fuller detail on velar fricatives, see Krauss 1977.)

---

[6] Final *x̭ > Kenai Tanaina š or x̭; final *γ̂ > Kenai Tanaina γ̂ or y (see Kari 1975:50). In other languages *γ̂ merges with *y. See also note 9 and section 5.1.5.

PA Ġ̲ > Ġ̲ in Koy., Ing., Tanaina, Aht., Hupa (final *x̣ and *q >
Hupa w, Mattole γ)
G̲ in Nav., Sar., Chip., Car., Kut., Tanana, Mattole
(initial *x̣, *γ̇ usually remain as such; final
*x̣ > Nav. h, Chip. Ø; final *γ̇ > Nav. Ø, Chip. Ø;
final *q(') > Nav. ').[7]

My initial *h is equivalent to Krauss's initial *Ø. In many cases the contraction *C(ə)-hV̲ > *CV̲ occurs, where *C(ə)- is in the prefix position (see Krauss 1969:60-61). Examples of overt stem-initial h are found, however, in Alaskan languages such as Kutchin, Koyukon, and Ingalik.

The manner of articulation of stem-initial obstruents is by and large unchanged in the daughter languages, except for occasional shifting from a fricative to the corresponding aspirated stop, or deaffrication of aspirated affricates. In Hupa and Mattole, however, the PA distinction between voiceless and voiced fricatives has been selectively simplified: Hupa *ɬ and *l remain, but the other sibilants are voiceless, and the back velar fricative is voiceless as absolute initial in nouns, elsewhere voiced to w (< *γ̇).

The number of stem-final contrasts in manner of articulation, however, is reduced in most languages. Stem-final glottalized stops are found among the languages represented in this sketch only in Ahtna, Tanaina, Hupa, Mattole, and usually in Sarcee where there is a vocalic suffix. In Mattole and Lower Ahtna, PA stem-final glottalized stops are phonetically preglottalized. Languages which keep the stop : fricative distinction but not glottalized stops are Ingalik, Koyukon, Tanana, Tanacross, and others. Stem-final affricates become voiced fricatives in Navajo, Chipewyan, Carrier, Sarcee, and other languages. Word-final voiced fricatives (and sonorants) become voiceless in Tanana, Koyukon, and Ingalik. Fricatives are also devoiced after full vowels in Ahtna, except in a few invariable stems. Stem-final consonant clusters are usually simplified by dropping one member, usually the second (see 3.4). Diverse languages have developed light:heavy stem syllable pairs, the light stem usually having a voiceless final, representing the original stem; and the heavy stem usually having a voiced final, representing the stem plus what was originally a vocalic suffix (see 4.5).

---

[7] Note also that [γ̇] and [γ̂] do not contrast in most languages, so that plain γ is written for PA *γ̇ (in Sar. and Nav. also PA *γ̂ > γ before a front vowel).

Kutchin is an extreme example of a language which has reduced the number of stem-final contrasts, having preserved nearly all stem-initial contrasts, but having weakened or lost nearly all syllable-final obstruents.[8]

1.2.2 Sonorants

Sonorant correspondences are covered in some detail in Krauss and Leer (1976). Note, however, that the merged reflex of final

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[8] These changes may be summarized for verb stems in Alaskan Kutchin as follows: *tł > l; *ts, *tš̱ > o; *tš̱^{w} > r; *ł, *l > a; *s, *z > Ø (a/__*i,e); *š(^{w}), *ž(^{w}) > o; *x̭, *y > i (*γ̃ > ɨ); *x̣, *γ̇ > Ø. If a non-Ø final follows a diphthongized vowel in Kutchin (see section on vowels), the diphthong is simplified by dropping the second member of the diphthong before the final.

*y and *ɣ̂ is i in some languages,[9] and that the reflex of final *ỹ is Car. i, Kut. ɨ, Ing. Ŋ (except that the perfective suffix *-ỹ > -N in Ingalik); elsewhere *ỹ merges with *n. In Tanana, Koyukon, and Ingalik, final nasals are devoiced in the light stem form, and are written N, Ŋ.

1.2.3 Vowels

The vowel correspondences are given below:

PA *i(·) > i(·) in Nav., Aht., Mattole, Sar., Chip., Car., Koy.
    i (~ oi/*q, *x̣, *ɣ̇__) in Kut.
    e in Ing. and Hupa (merges with *e in Hupa)

PA *e(·) > e(·) in Nav., Aht., Car., Mattole, Hupa
    ɛ, e in Chip.
    a (phon. ranging from [æ] to [a]) in Sar., Tanana, Koy., Ing.)
    merges with *i in Kut.

PA *a(·)>a(·) in Nav., Aht., Matt., Chip., Car., Hupa
    o (phonetically ranging from [o] to [ɔ]) in Sar., Tanana, Koy., Ing.
    u in Tanaina
    e, i (~ a/*ʼ, *h, *q, *x̣, *ɣ̇___C) in Kut. (does not palatalize preceding D-series obstruent)

---

[9] The question of contrast between original final *y and *ɣ̂ is quite problematic. They are apparently sometimes kept distinct only in Kenai Tanaina, cf. Gəy 'be white' < PA *Gɑy and tsəɣ̂ 'poke with stick' mom. perf. < PA *tsəɣ̂. However, the correspondences are not always consistent with what is expected by comparison with Eyak.

PA *u(·)> u(·) in Aht., Sar., Chip., Car., Koy.

o(·) in Nav., Matt.

o in Hupa

io (~o/*q,*x̣,*γ̇__) in Kut.

merges with *i in Ing., Tanaina

PA *ə > ə in Car., Koy., Ing., Tanaina, Hupa

i̲, i in Mattole (variable in Li's transcription)

i in Sar., Matt. (merges with *i in Sar.)

i (~a/__*Ġ̲) in Nav.

e (~ a/__*Ġ̲) in Ahtna

ə, e (~a/__ *Ġ̲, ~ i/__*(X)Ĝ̲) in Chip.

a (~e/__*x̣, *γ̇) in Kut.

PA *ɑ > ɑ in Koy., Hupa

a in Nav., Aht., Matt.

a(~ai/__*(X)Ĝ̲) in Chip.

o in Sar. (merges with *a)

merges with *ə in Car., Kut., Ing., Tanaina

merges with *ʋ in Tanana

PA *ʋ > ʋ in Tanana, Koy., Ing., Hupa

o in Nav., Kut., Aht., Matt.

o(~u/__*(X)Ĝ̲) in Chip.

u in Sar. (merges with *u)

ə with rounding of adjacent back velar in Car.

merges with *ə in Tanaina

Length of full vowels was evidently not phonemic in PA[10]. Full vowels were long except immediately preceding *’ or the negative enclitic *-he·. Long:short contrasts between full and reduced vowels, where length is phonemic with some vowels, have developed in Navajo, Ahtna, and other languages. In Navajo, for example, we find more than one reflex for stems of the shape *CV’, namely CV̀’ in verb stems and CV̀·’ in noun roots, and for *CV·N’, we find (phonologically irregular) CV̨́·’ in verb stems but CV̨̀·’ in noun roots.

For reference, the usual Navajo reflexes of non-obstruent-closed verb stem types are as follows:

*CV· > CV́ *CV’ > CV̀’,[11]
*CvN > CV̀N *CvN’ > CV̨̀’
*CV·N > CV̨́ *CV·N’ > CV̨́·,[11]

1.2.4 Constriction

The reflexes of the PA contrast between non-constricted and constricted vowels are reflected in the daughter languages by two opposite types of tone systems. (For a more detailed treatment, see Krauss 1978.) The high-marked type is here represented by

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[10] Phonetically, although probably not phonemically, vowel length contrast may have arisen from the suffixation of the possessive suffix *-ə’ to a stem of the shape *CV’, e.g. PA ya’ 'louse', poss. */ya(h)ə’/ < *-ya·’, as seen in Aht. ya’, poss. -ya·’; but note Nav. yà·’, poss. -yà’ (< *ya’ə’ ?!). Similar light:heavy contrasts are found with other root types.

[11] Occasionally the reflexes CV́·’ < *CV’ and CV̨̀·’ < *CV·N’ occur in Navajo verb stems; the reason for these exceptions is still unexplained.

Chipewyan, where *V̓ > V́ and *ϑ > V̀ (ϑ here represents a specifically non-constricted vowel). Other languages which have basically the same tone system are Beaver, Slavey, Mountain-Bearlake-Hare, Chilcotin, Kaska, Northern Tutchone, and Tanacross (see Krauss 1978). The rest of the tone languages have low-marked tone systems, where *V̓ > V̀.[12] The reflexes of *ϑ, however, show some variation in low-marked languages. In Kutchin, and probably other Canadian languages, *ϑ > V́ in stems, whereas in Navajo, and apparently also Sarcee, unconstricted reduced stems have a low-toned or lowered tonal reflex. In Sarcee, it appears to be the case that *V̊ > V̄ and *ϑ > V́[13]; in Navajo, *V̊ > V̀ and *ϑ > V́(·). The tone reflexes of *CV·, *CvR, and *CV·R stem syllables agree with those of non-constricted syllables, and in general, the tone reflexes of *CV', *CvR', and *CV·R' stem syllables agree with those of constricted syllables, but note the exceptions in Navajo mentioned above (1.2.3).

1.2.5 Nasalization

Examples of nasalized vowels arising from addition of an obstruent suffix to a nasal-final root are numerous (see 2.3.3).

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[12] In prefixes constriction (PPA *V'- > PA *V̓·-) can also be postulated, as in the inceptive perfective P̦PA *te'siya·wỸ 'he is starting off, is going to go', PA *tė·z(ə)ya·, Nav. dè·zyá, Chip. tɛ́ðyà, Kut. hà·z̭í· (< *tȉð-), Tanana tȁðyo.

[13] Sapir used a phonetic, not necessarily a phonemic system of tone marking for transcribing Sarcee. Robert Young also kindly sent me his own Sarcee field notes; his tonal transcriptions are also phonetic, and often disagree with those of Sapir. E. D. Cook has described certain morphophonemic rules operating on tone in Sarcee prefix syllables (Cook 1971), which are based on those previously outlined by Sapir (1925a), but stem tone in Sarcee has never been phonemically described or documented in a form that could be called phonemically adequate.

Such nasalization is attested only in Navajo and Chipewyan (among the languages represented in this sketch); no Alaskan language having nasalized vowels (Tanacross, Han, Kutchin) has nasalized reflexes of these originally nasalized vowels. Some languages have lost nasalization entirely, such as Sarcee, Carrier, Tanana, Koyukon, Ingalik, Tanaina, and Ahtna.

PA also had nasalized roots, probably arising from PPA *CvNvX and/or *CV̲NX roots (see 5.1.3). The status of these roots is quite problematic, and will be treated here only briefly. In brief, however, root-integral nasalization is sometimes attested in Alaskan languages. Furthermore, a root which is nasalized in one language (especially Navajo) may not be nasalized in others. For example, the stem cited by Sapir and Pinnow as *t'ans 'cut' appears as Navajo perf. t'ą́·z, but Chip. t'ȁz, Hare t'ȁ. There are, however, a small number of roots which are attested as nasalized in both Navajo and Chipewyan. We find a suggestion in one case that reduced vowels corresponding to nasalized full vowels may not have been nasalized in PA, cf. Chip. perf. k'ų́z 'become red' but reduced impf. k'ȍs; reduced neuter k'óz 'be red', Hare k'ȍz.[14]

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[14] The main problem with the reconstruction of nasalized roots is that there does not seem to be a plausible source for reduced nasalized stems. According to 3.4, a root of the supposed form *CV̲NX might have a suffixed reduced root PPA *CvNX-X, for which we would expect PA *CV̨·X-X according to 2.3.3. Thus we would expect both non-reduced and reduced stems to have full nasalized vowels in PA. Perhaps reduced nasalized stems in PA were produced by a late rule *CV̨·X-X > *CV̨XX due to analogy with the much larger class of non-nasalized roots. Alternatively, perhaps nasalization was a common feature of PAE. Eyak also has nasalized roots, but as in Athabaskan, their original status is unclear. It seems more likely, however, that the nasal element was originally a segmental. As Sapir pointed out (Newman 1936:14b), the common root PA *wą·ts' (??) 'be round, roll' may be a suffixed form of *wən (?) cf. Hare -mèn, -méné 'be round'.

1.3 Aspects of PPA phonology

Several differences in the orthography used for reconstruction of PA and PPA forms should also be noted here.

1.3.1 Obstruent series

The PA *Ĝ̲ and *DŽ̲^{w} series are written as *G̲ and *G̲^{w} in PPA: PPA *dəkən 'stick' > PA *dək̯ən; PPA *k^{w}ək^{w} 'firewood' > PA *tš^{w}ətš^{w}. The reasoning behind this is that the front velar series became palatalized during the history of Athabaskan, so that *k became *k̯; in post-PA this series became affricated in most Athabaskan: *k̯ > tç̯, etc. The labialized series, however, had apparently become affricated at an earlier date (see Krauss 1977), so that PPA *k^{w} > *k̯^{w} > PA *tš^{w}. PPA is also reconstructed with a labialized uvular series *Ġ̲^{w}; in PA these merged with the non-labialized series, accompanied by a rounding of reduced stem vowels to *ʊ: PPA *G^{w}e't-Ỹ* 'dig' perf. > PA *Gė·t, but PPA *G^{w}et-ł prog. > PA *Gʊł. In one case also a labialized glottal stop has been reconstructed: PPA *'^{w}e·tł'-Ỹ 'float, pl. swim' perf. > PA *'e·tł', but PPA *'^{w}ətł'-ł prog. > PA *'ʊ̀łł (see Krauss 1964:122).[15]

1.3.2 Vowels

The number and status of reduced vowels in PPA is not definitely reconstructible, but along with Krauss I have posited three reduced (short) vowels in PPA stems: *ə , *a

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[15] In Morice's Carrier data we find two stems of the shape γ^{w}iX: pf. γ^{w}ət, mom. IO γ^{w}it '(fish) wriggles'; and pf. γ^{w}əl, mom. IO γ^{w}ił 'break, snap'. To the latter corresponds Aht. pf. γotł', mom. IO γu·ł 'break, snap'. It is not clear if the Carrier forms are survivals of PPA *x̣^{w}i·X or dissimilations from PA *γ̇u·X. Note that there are no attestations of *γuX/*γ^{w}əX alternations in Morice's Carrier data, and see Story 1978 for Babine and Carrier correspondences.

(=PA *ɑ), *u (=PA *ʊ). It is possible, though, that there was a contrast between short *i and *e at this period, since *ə may lengthen both to *i· and *e· in lengthened stems. However, this seems less likely in view of the fact that the lengthened stem vowel is nearly always predictable from the surrounding consonants (see 3.3). In prefix syllables, however, a contrast between short *i and *ə might be posited for this period, specifically in the classifiers *də/di (>PA *də) and *łə/łi (> PA *łə~l(ə)) (see Krauss 1969). I therefore use *ə in stems to represent the indistinct vowel which is the reduced equivalent of both full *i and *e, whereas I use *ə in prefixes to represent an indistinct vowel which may be contrasted with *i, but not with *e and *a. This is quite similar in principle to the merger of reduced e and a which Krauss writes as ə in Eyak (Krauss 1965:168).

Krauss (1964:123) also points out the instability of the reduced vowels due to the influence of surrounding consonants. Besides the labialization of PPA *ə and *a to PA *ʊ mentioned above, we find with verb stems that PPA *u > PA *ə /*Ĝ̱__ in some cases: PPA *ku't-Ỹ 'grasp' perf. > PA *ḵ̭ủ·t, but PPA *kut-ł prog. > PA *ḵ̭əł. The shift PPA *ə >PA *ɑ/__*Ġ̱ is also common, as can be seen in the listed reflexes of *ə. The latter, however, should be attributed to post-PA or PA dialect phonology, since it is not universal.

1.3.3 Voicing of fricatives

Finally, only voiceless fricatives are reconstructed for PPA (as in Eyak and Tlingit), the premise being that intervocalic fricatives become voiced in PA (see Krauss 1965:187). Thus verb-stem-initial fricatives were probably voiceless when immediately preceded by an obstruent (the ł- classifier or the 1.s. or 2.pl. subject pronoun), but were otherwise voiced, as is the case in Navajo, Chipewyan, Kutchin, and other Canadian languages.[16] In this sketch, verb-stem-initial fricatives are written in normalized form, as voiced fricatives.

One important exception to the generalization that voicing occurs mainly intervocalically is in verb-stem-final position where the verb stem has a reduced vowel. Here fricatives appear voiced in all languages which maintain the contrast between voiced and voiceless stem-final fricatives: PPA cont. IO(F) *ỹəł 'spill',[17] > PA *ỹəl, Nav. nìl, Car. yəl, Tanaina nəl. The same phenomenon occurs sporadically in noun stems: PPA *dəł 'blood' > PA *dəł or *dəl, Nav. dìł, Kut. dáh < *də́ł, but Chip. dȅl, Aht. del. For further comment see 2.3.5, 3.2 and 4.5.

Other important diachronic changes in the phonology of Athabaskan will be taken up in section 2. These are spirantization, the development of constricted and nasalized vowels, and the origin of ablaut, as illustrated by the development of verb stem variation in Athabaskan.

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[16] In Carrier, Ingalik, Koyukon and Tanana, however, verb-stem-initial fricatives are always voiced and in Hupa and Mattole these initials reflect earlier voiced fricatives (*z and *ž(^{w}) being regularly devoiced). In Ahtna and Tanaina initial *l, *z, *ž(^{w}) contract with the ł- classifier and the 1.s. and 2.pl. subject pronouns; otherwise these initials are voiced.

[17] See note 27.

2. Evolution of the Athabaskan Vowel Nucleus System

2.1. History of the analysis of Athabaskan verb stem variation

Verb stem variation has remained one of the most interesting and puzzling features of Athabaskan languages. Several students of Athabaskan languages have attempted to analyze and organize verb stem variation into classes, but the development of the bewildering variety of stem variation has still never been explained. The study of verb stem variation in Athabaskan may be divided into three main eras: pre-Sapir, the Sapir school, and post-Sapir.

In the first group we include dedicated early workers like P. E. Goddard and Fathers Jetté and Morice. Other than isolating some of the more obvious suffixes, such as fut.-prog. -ł, and rep.-cust. -x̭, (here *k), they did little more than list stem sets. Father Jetté (1905) isolates also the perfective suffixes -n (PA *-ỹ) and -t, and notes that future and customary stems are reduced in Koyukon.

Sapir certainly knew much more about verb stem variation in Athabaskan than has been published by Hoijer (1949, pt. V, and Sapir and Hoijer 1967); much valuable documentation of his thought on this as well as other Athabaskan matters is preserved in the notes of his students in comparative Athabaskan courses at Yale, between 1931 and 1936. Swadesh's notes (1932:72) list the following suffix inventory: momentaneous *x̭, progressive *ł, iterative *g̭; he later notes that the perfective stem was formed by suffixation of a nasal or by voicing, as well as pointing out that low tone is characteristic of Navajo continuative forms (see note 30). The class notes also indicate, however, that Sapir believed glottalized final consonants were derived from a stop or fricative followed by a glottal stop.

Hoijer (Sapir and Hoijer 1967, especially pp. 56-67, 101-103) attempts only to describe Navajo verb-stem variation and not derive it, but others in the post-Sapir era showed continued interest in designing a derivational system for explaining Navajo stem variation: Pike and Becker (1964), Stanley (1969, chapters 3,4), and Pinnow (1974). Pike and Becker independently rediscover the future suffix -ł and the repetitive-customary suffix -h (= *-k), but posit *-z (!) as the perfective suffix. Stanley and Pinnow add somewhat to the basic principles laid down by Sapir, attempting to posit suffixes (Stanley ', Pinnow *ŋ) to account for high tone, but without developing a clear theoretical basis for the origin of tone classes. An attempt is made to account for the continuative imperfective by means of suffixes (Stanley ', Pinnow *x). Basically, however, theories such as these are too powerful: taking a given root, one can construct all kinds of stems by means of the derivational theory, but how is one to know why a given stem set is chosen out of all the possibilities? Finally, Hardy (1979) provides a profusely exemplified and useful generative description of Navajo stem variation which incorporates some of the ideas given in the present paper, often in modified form.[18]

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[18] In 1978 Hardy made two visits to ANLC to confer with Jones, Kari, Krauss and Leer regarding the growing knowledge of the verb morphology of conservative Alaskan Athabaskan languages, and to gain first-hand knowledge of the theoretical framework we are using in analyzing verb stem variation. His paper thus represents the first attempt to analyze Navajo verb stem variation within this framework, and the results are quite informative and useful, especially owing to his careful categorization of stem set types. Nevertheless, Navajo presents a much more diversified and idiosyncratic system of verb stem variation than those of Alaskan languages, almost certainly due to analogical innovation, which is thus quite difficult to analyze synchronically.

Less work has been done on describing verb stem morphology in other languages. Li's descriptions of verb stem variation in Mattole (1930b:41-51), Sarcee (1930a), and Chipewyan (1933b, sections 60-87) show close association with Sapir's analysis. Golla (1970) provides a concise and useful description of Hupa verb stem variation. Cook's (1972) description of Sarcee verb stem variation, however, does not add much to Li's previous description (1930a). Kari's (1979) analysis of Ahtna verb stem variation provides the first complete description of the verbal system of a conservative Alaskan Athabaskan language, and thus is of great comparative interest. Since Kari's paper was written in connection with the theoretical framework given in this paper, the interested reader may wish to refer to Kari's paper for a synchronic application of this theory.

Observations connected with the general theory of verb-stem variation were also made by Krauss (1964), who from his fieldwork with Eyak had developed a somewhat unique view of PA. In particular, his theory that PA stems had the shape CVT, where T = n ' C′ $\begin{Bmatrix} \text{ɬ} \\ x \\ d \end{Bmatrix}$ ' ə $\begin{Bmatrix} ? \\ \emptyset \end{Bmatrix}$ (p. 124)[19] is the first where syllable-internal glottal stop is reconstructed for PA, and he notes that subsequent development of tone was "certainly intimately connected" with this glottal stop (p. 123). Krauss also notes that stem vowels are reduced under conditions "having to do with the filling of positions in the stem after the vowel" (p. 121).

The theory presented here has one major difference from those which have been considered previously. Rather than trying to explain all stem variation, including stem tone, in terms of suffixes, it is assumed that Athabaskan originally had root configurations similar to those found in Eyak and Tlingit -- roots could end in non-glottalized and glottalized obstruents as well as any sonorant. Furthermore, it is assumed that productive phonological rules of stem alteration were originally rather simple and direct rules. So stem variation, including tone, is explained as having developed due to regular phonological processes operating on underlying roots.

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[19] Note that Krauss postulates three positions of glottalization in the syllable, but does not include glottalized obstruents among stem-final consonants (C′).

2.2. The Eyak and Tongass Tlingit vowel nucleus systems

During the course of my work with Tlingit, I met and later began to work with Frank and Emma Williams of Ketchikan, who speak the nearly extinct Tongass dialect of Tlingit.[20] The most interesting characteristic of this dialect of Tlingit from a comparative standpoint is its preservation of what was apparently the original vowel nucleus system of Tlingit. Tongass Tlingit has a system of non-tonal vowel modification which corresponds to the tone system found elsewhere in Tlingit. In the Tongass dialect, stem vowels may be modified in three ways: (1) by lengthening (sustained vowel Vˑ), (2) by closing the glottis (glottalized vowel V’), or (3) by opening the glottis, resulting in a rapid fading of volume and pitch, accompanied in some cases by breathiness (fading vowel Vˋ). These three nucleus types correspond to long vowels elsewhere in Tlingit: Tongass Vˋ, other V̀ˑ; Tongass Vˑ, other V́ˑ; Tongass V’, Craig-Klawock-Ketchikan V̂ˑ, Northern V́ˑ. Thus both Tongass Vˑ and V’ correspond to

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[20] For further information see the introduction to Williams, Williams and Leer 1978 (pp. 6-16).

Northern V́·, showing that the three-way contrast found in Tongass and Craig-Klawock-Ketchikan is conservative, and that the two-tone system of Northern Tlingit is the result of a merger of V’ and V· as high tone.

These Tongass vowel modifications resemble remarkably those found in Eyak, which is located at the northern end of the Tlingit language area, while Tongass is at the extreme southern end. According to Yakutat tradition (the late Harry Bremner, personal communication) Tlingits moved from the south next to the Eyaks in recent times, almost certainly after the tonal system of Northern Tlingit had evolved. This seems to rule out the possibility of recent influence as an explanation of the similarity between the Eyak and Tongass Tlingit systems of vowel modification. In fact, the Eyaks are called by the Ahtna, their neighbors to the north, danGane 'uplanders', and various Tlingit traditions relate that the Tlingits moved down the major coastal rivers from the interior in the remote past. These two facts seem to indicate that when the Tlingit and Eyak peoples were previously in close contact, and susceptible to mutual influence, it was at a remote time, and probably inland, rather than on the coast. For this reason, it seems most likely that the Eyaks and the Tongass Tlingits have independently preserved somewhat different varieties of the original Na-Dene system of vowel modification, that they are both relic systems rather than independently innovative.

Table 2. Comparison of Eyak and Tlingit stem vowel nuclei

Eyak	Tlingit		
	Tongass	Craig-Klawock-Ketchikan	Northern
V (reduced)	V (short)	V́	V́
Vh (short aspirated)	Vˋ (fading)	V̀·	V̀·
V’ (short glottalized)	V’ (glottalized)	V̂·	V́·
V· (long)	V· (sustained)	V́·	V́·
V·’ (long glottalized)	---		

Within the Tlingit system, Tongass fading, glottalized, and sustained vowels all correspond to long vowels in the other Tlingit dialects, and thus can be considered the three types of modified or long vowel as opposed to the unmodified or short vowel. In Eyak, however, length must be considered separately from aspiration and glottalization, since length may be followed by glottalization. According to Krauss (p.c.), the structure of non-reduced vowel nuclei may variously be described as V ± · ± ’ (where V − · − ’ = Vh) or as V ± · + $\left\{\begin{matrix}h\\ ’\end{matrix}\right\}$ (where V + · + h = V·). In any case, the three-way opposition found with Tlingit, Eyak, and (P)PA stops (plain:aspirated: glottalized) is suggestively echoed in the vowel nucleus systems of Eyak and Tongass Tlingit.

Assuming that the earliest Athabaskan had a system of vowel modification similar to that found in Eyak and Tongass Tlingit, it becomes possible to account both for the development of tone and for the evolution of verb stem variation in Athabaskan by the same theory. As we shall see, this theory also accounts for the development of nasalization and vowel ablaut in the stem vowel.

To account for the development of tone in modern Athabaskan languages and especially for the tonal morphophonemics of verb stem variation, it is necessary to posit three types of vowel nuclei in PPA obstruent-closed stems: *reduced* or short (or perhaps simply unmodified) vowels (v), and two types of *full* vowels, *glottalized* vowels (V') and *long* vowels (V·).[21]

2.3. Spirantization and suprasegmentalization

During the transition from PPA to PA, I postulate that two related phenomena occurred, probably at approximately the same time: *spirantization* and *suprasegmentalization*. Spirantization operated on root-final stops; if the stop was glottalized, in the process of spirantization this glottalization became suprasegmentalized, appearing as constriction of the stem vowel. Suprasegmentalization also operated on postvocalic glottal stop and sonorants, both in stem syllables closed with an obstruent, and in prefix syllables.

2.3.1 Spirantization

Spirantization operated on root-final stops in certain environments: *T, T' > *S. Note, however, that *t, t' > *t, since there is no fricative in this series. If the root-final consonant was a glottalized consonant, the stem vowel became constricted when spirantization occurred: *CV̲T' > *CV̲̓S,

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[21] Interesting to note is the development of phonetically aspirated and glottalized vowels in Hupa. According to Golla (1973:13-14), morphophonemically full vowels are aspirated before syllable-final non-glottalized consonants and glottalized before syllable-final glottalized consonants, but are long in morphophonemically open syllables. This system of vowel modification only superficially resembles that of Eyak, Tongass Tlingit, and that here reconstructed for PPA, where the postvocalic glottal modification is phonemic and not simply phonetic. Thus, for example, the Hupa reflex of both PPA *te'-ł 'mat' and *te·-ł 'sg. lie' prog. is teł [tehł].

*CV̱t' > *CV̱̓t, e.g. PPA *gəts'-ł > PA *ĝə̓sł 'hook' (Chip. džɛ́θ, Car. džəs, Kut. džàł (< *džə̀tł < *džə̀θtł), Koy. gəłtł, Aht. ges; see also *tł'ət'-ł under 3.4.1). Furthermore, stems of the PPA type *CV'X have a constricted vowel in their spirantized form (as well as in their non-spirantized form), e.g. PPA *ni'k 'move hand' cont. IO(F) (non-suffixed) > PA *ni·x̣̓ (see 3.2).

There are two environments where spirantization of root-final obstruents occurs: (1) when followed by an obstruent suffix, e.g. PPA *t'aq-ł 'fly' prog. > PA *t'ɑx̣ł (see 3.5.1), and (2) in verb-stem-final position where the stem vowel is full (either word-finally or before an enclitic, see 4.5), e.g. PPA *t'a·q 'fly' mom. imperf.-opt. > PA *t'a·x̣. This latter phenomenon is also found (although not consistently) in noun stems: PPA *dže·q' 'pitch' > PA *dže̓·x̣, Nav. džè·h, Sar. dzàh, Chip. dzɛ́, Car. dzeh, Kut. dzìh, Koy. dzax̣, Aht. dze·x̣, Hupa džew, poss. -džewə', but also -džeq'ə' '(snail's) slime', cf. the denominative verb root *dže·q' 'cover with pitch'. Further compare PA *šu̓·x̣, Eyak ši·q', (Tongass) Tlingit šu`x̣' 'robin'. In some nouns we find that the daughter languages disagree as to whether a given noun stem is spirantized: Eyak ts'əx̣łiqa·tł' 'nagoonberry', Tanana nkotł 'cloudberry', Tanaina nqutł', but Ahtna nqa·ł.[22] Other important examples of spirantization are the repetitive-customary suffix *-k (see 3.4.3) and the postposition PPA *(hə)tł' 'with', PA *(h)ə̓ł, Nav. -ł, Chip. (x)ɛ́ł, Kut. (h)àh or (h)à·,[23] cf. Eyak -tł'.

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[22] Compare also the variability found in some reduced noun stems ending in a fricative, the final fricative being voiceless in some languages and voiced in others (see 1.3.3 and note 28).

[23] *(hə-) is the "peg" prefix.

2.3.2 Constriction

The second phenomenon I call constriction, which involves the transformation of a sequence of vowel plus glottal stop, or in some environments a vowel followed by a glottalized consonant, into a vowel which was suprasegmentally modified by glottalization. This suprasegmentally modified vowel, which I term a constricted vowel (V̲̓) in reconstructing PA, contrasted with a non-constricted vowel (V̲ or unambiguously V̲̊) in that it was articulated with glottal tension. In other words, glottalization was coarticulated with the vowel in the form of partial glottal closure. Constriction had three sources:

(1) from a medial glottal stop preceding final obstruents and in prefix syllables: *V' >*V̓·/__X, e.g. PPA *te'-ɬ > PA *te̓·ɬ 'mat', cf. Eyak te'-ɬ 'mattress', from the root *te 'sing. lies';

(2) from spirantization of stem-final glottalized consonants: *CV̲T' >*CV̲̓S, *CV̲t' >*CV̲̓t (see 2.3.1);

(3) in all cases where a reduced root vowel was followed by a root-final glottalized consonant (*CvT' >*Cv̓T'), e.g. PPA *-wət' > PA *-wə̓t' 'belly', Nav. -bĩd, Sar.-mĩ', Chip.-bə́r, Car. -bət, Kut. -vàt, Koy. -bət, Aht. -bet', Hupa -mət', Mattole -bi'ɬ. During the post-PA period, the contrast between constricted and non-constricted vowels evolved into the two opposite tone systems described in section 1.2.4.

2.3.3 Nasalization

The second suprasegmentalization phenomenon is nasalization, whereby a vowel followed by a nasal sonorant became a long nasalized vowel: *V̲N >*V̨·/__-X , e.g. PPA *-nə-tšən-k > PA *n(ə)tšɨ̨·x̭ 'nose', root *tšən 'smell'. Nasalization (as well as ablaut, see 2.3.4), could of course co-occur with constriction, thus *V̲N' > *V̨̓·/__-X. Nasalization operates as described below in the presence of a following obstruent suffix.

(a) *i·n, *e·n, *i·ỹ, *e·ỹ, ən, əỹ > ɨ̨·

(b) *u·n, *u·ỹ > ų·

(c) *a·n > { ɨ̨·/not following a uvular
             ą·/following a uvular }

(d) *a·ỹ > { ɨ̨·/not following a uvular in active stem sets
             ą·/following a uvular or in neuter stem sets }

(e) *aỹ > ą·/following a uvular or in neuter stem sets
          (elsewhere ablaut occurs; see 2.3.4)

As the above rules indicate, the behavior of *a·ỹ and *aỹ is partially determined by the stem set type. Thus for example, the repetitive-customary stem of the durative (active) stem set of *na·ỹ 'drink' is PPA *na·ỹ'-k > PA *nɨ̨̓·k̭ or *nɨ̨̓·x̭, but the rep.-cust. stem of the neuter stem set of *xa·ỹ 'be aware' is PPA *xa·ỹ'-k > PA *γ̂ą·k̭ or *γ̂ą̓·x̣.

2.3.4 Ablaut

The third phenomenon, ablaut, is the latest addition to the suprasegmentalization theory. The following hypothesis concerning ablaut arose from the observation that although stems ending in PA nasal sonorants (*n, *ỹ, *w̃) may be reconstructed, there are virtually no cases of PA stem-final non-nasal sonorants (*y, *w; *y not to be confused with *γ̂ < PPA *x̯ by voicing, see also 1.2.2, 5.1.5, and notes 9, 42). This gap in the distribution of sonorants suggests that non-nasal final sonorants may have existed in PPA, but were lost by PA times. This hypothesis is confirmed by the fact that nasalization and ablaut are in complementary distribution. These two processes are thus different manifestations of a single underlying phenomenon. Ablaut may then be strictly defined as the process by which PPA sonorants are absorbed into the stem vowel without causing nasalization.

The behavior of ablauting stems is accounted for by two rules. The first rule pertains to the dropping of non-nasal sonorants after full vowels. This process is not ablaut, but rather non-nasal sonorant dropping.

1.a. $*V^{\cdot}\left\{\begin{matrix}y\\w\end{matrix}\right\}\ \text{-}\tilde{Y} > *V^{\cdot}$, where *-Ỹ is the perfective suffix (see 3.1 and 4.3)

b. $*V^{\cdot}\left\{\begin{matrix}y\\w\end{matrix}\right\}' > *V'$[24]

c. $*V^{\cdot}\left\{\begin{matrix}y\\w\end{matrix}\right\}'\text{-}X > *\overset{,}{V}{}^{\cdot}X$

If the vowel preceding the sonorant was reduced, then ablaut occurred; that is, the vowel and the sonorant were blended into a vowel which was sometimes different from the original vowel (compare Krauss 1964:123). In a few roots the sonorant *ỹ is also posited as having given rise to ablaut. The following such contractions have been posited:

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[24] In Car., Koy., and Aht. also *V·ỹ' > V' (see 4.6.5, L'-Ỹ stem).

2.a. *aw > *a(·)

b. *ay, *aỹ>*e(·)/except following a uvular (see also under nasalization, 2.3.3)

c. *əw > *u(·)

Contractions 2.b. and 2.c. account for all cases of what is presently describable as open-root ablaut in modern Athabaskan languages (except for that found in *ni 'become thus', see note 34). Contraction 2.a., on the other hand, yields a vowel which is identical with the original stem vowel, and thus is not described as ablaut in terms of the modern languages. Note particularly that stems of the shape PA *Cɑỹ (and apparently also *Cɑy, see 5.1.5) exist, but only where C is a uvular. Hence the exception to 2.b. above.

Stem-final *y and *w are postulated in non-ablauting stems where the basic perfective stem lacks the suffix *-ỹ characteristically added to open roots in PA. For example PPA *'a·w 'extend' > PA neuter perfective 'a· (not *'a·ỹ, as in the case of *'a 'classificatory root for compact object', which is by origin an open root). Interesting confirmation of this postulation is found in this case (and in a few other cases[25]) in Eyak, where the adjectival form 'a·w 'long' is found alongside the verb stem 'ah~'a' 'extend'.

Contrasting with this non-ablauting root is the ablauting root PPA *(ɫ-)ha·y 'classificatory root for plural objects', which appears in PA with the perfective stem *la·, ablauting to *le˙(-) < PPA *ł-hay(-) (see 4.1, 4.4, and 4.6.4). (The conditioning for reduction resulting in ablaut will be discussed in 4.1.)

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[25] Such are the correspondences for PPA *t'e·w 'be (thus)', PA neut. pf. *t'e·, Eyak t'e~t'u´, (note also Car. neut. pf. t'oh (Morice ṭorh)); and PPA *qe·w 'pl. sit', PA neut. pf. *qe·, Eyak qu.

There are also a few ablauting roots which have final *ỹ in the perfective stem; these are reconstructed as roots ending in *ỹ, that is, the final *ỹ is considered to be part of the root and not the perfective suffix. Such a root is PPA *sa˙ỹ 'tan (hide)', PA perfective *za˙ỹ, ablauting to *ze˙- < PPA *saỹ- (note that the Eyak cognate is nasalized: sąh 'flesh (sealskin)'). Compare for example the following perf./imperf. stem pairs: Nav. zą́/zé˙h, Sar. zó(n-)/zá, Chip. ðą̂/ðɛ̂(h), Car. dzai/dzeh, Kut. ɣí·/ɣí·, Koy. loN/lax, Aht. za˙n'/ze˙x̣.

The ablaut *əw > *u˙ is attested in only one root, PPA *(də-)łi˙w '(anim.) becomes cold, freezes', PA pf. stem *dli˙, ablauting to *dlu˙ < PPA *də-łəw(-), as attested in the perf. (neuter)/imperf. (transitional) pairs Nav. dlí/dló, Chip. dlî/dlû, Kut. dlį́·/dlío·, Koy. dli/dlux̣, Aht. dli˙/dlu˙x̣, Hupa le/--.

One interesting fact about ablaut is that it occurs only with active verb themes, not with neuter themes. Hence, ablaut does not occur with *qe˙w 'pl. sit', even though one might expect *əw > *u in some stems. In the case of neuter themes ending in *ỹ, nasalization occurs instead of ablaut in neuter stem sets. For example, from the root PPA *xa˙ỹ 'grow', the I(OF) stem for the x̣-suffixed active stem set is *xaỹ-x̣ > *ɣ̂e˙x̣, but the customary stem of the neuter stem set is *xa˙ỹ'-k > *ɣ̂ą̀˙k̯ or *ɣ̂ą̀˙x̭ (see 4.6.6). Thus an important point: ablaut and nasalization are in complementary distribution, both arising from a blending of the features of a postvocalic sonorant (nasalized, rounded, front) with the vowel, and hence may be considered variants of the same phenomenon.

This theory of the origin of ablaut raises an interesting general question as to the status of open stems in Na-Dene. It may be that some roots which are fully open in PA originally had the form $*C \begin{Bmatrix} \text{ə} \\ a \end{Bmatrix}\begin{Bmatrix} y \\ w \end{Bmatrix}$, since the reflexes of the sequences *ay, *aw, *əw and presumably also *əy, merged with full vowels in PA.[26]

2.3.5 The nature of suprasegmentalization

In general, then, suprasegmentalization operates on (1) postvocalic glottal stops (constriction) and sonorants (nasalization and ablaut) by changing what was originally a sequence of segments into a simultaneous articulation of features of both the vowel and postvocalic segments. The other main process, spirantization, operates on stem-final obstruents, changing final stops into fricatives and in the case of glottalized obstruents, converting the glottalization into constriction of the stem vowel. Hence the two phenomena are related in that constriction can arise from either process, and in that both processes affect the part of the stem syllable which follows the initial consonant. Furthermore, both processes can roughly be described as feature-diffusion phenomena. Thus it seems likely that they both evolved at roughly the same time in the history of Athabaskan, due to drift toward articulation of the final part of a stem syllable less distinctly than the initial part. This tendency has continued up to the present time in many Athabaskan languages (see 1.2.1).

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[26] One suspicious root is 'make, give birth to sing. O', which for most languages appears to be reconstructable as *(ł-)tši. An alternate reconstruction, such as *tšəy, is suggested by the Kutchin perfection stem tsaɨ (rather than the expected *tsɨ; presumably from earlier *tšəỹ), and the Tanacross perf. and IOF stem tsęy (also < *tšəỹ), and most strikingly, by the Han perf. stem tsąy (< *tšəỹ) as contrasted with the IOF stem tsey (< *tši˙) (personal communication from John Ritter). These forms appear to suggest the striking development PPA *tšəy > PA *tši˙, but PPA *tšəy-Y̆ > *tšəỹ, at least for one dialect area (with the subsequent replacement of *tši˙ by *tsəỹ in Tanacross). The lack of the *-ł suffix in the Tanacross and Han OF stems conforms with the pattern of sonorant-closed roots and not open roots.

Also, the root *tł'u 'tie, weave' may originally have been *tł'əw, compare Eyak tł'i 'tie' and note the Babine imperfective negative stem tł'əw (p.c., James Kari). Further research may turn up other interesting survivals such as this (see also 3.4.6).

One feature of suprasegmentalization that should not be overlooked is that reduced-vowel stems may behave differently from full-vowel stems when these historical processes are applied. We have already remarked in 1.3.1 that original labialized uvulars do not affect full vowels, but labialize reduced vowels to PA *ʋ. In 1.3.3 we see that voicing of stem-final fricatives (without obstruent suffix) occurs with reduced-vowel stems only. Related to this is the fact that stem-final obstruents (without obstruent suffix) fail to spirantize if the stem vowel is reduced (see 3.2). Another place where such disparity is found is in the development of constriction: PPA *CvT' > PA *Cv̓T', but PPA *CV·T' > PA *CV̊·T'. Finally, ablaut develops from PPA *CvR but not from *CV·R. (For a further case in point, see 4.5.)

Such differences, although too diverse to group as a single phenomenon, seem to stem from the compactness of a reduced-vowel syllable as contrasted with the roominess of a full-vowel (long) syllable. The compactness of reduced syllables leads to interaction between the vowel and the final consonant (feature diffusion): voicing is extended to the final fricative; uvular obstruent labialization and final obstruent glottalization leak onto the stem vowel in the form of labialization and constriction; the properties of a sonorant fuse with the stem vowel. Such interaction is even more striking in view of the fact that it may take place in the absence of an environmental stimulus, such as a suffix.

The major type of canonical stem shape in PPA is thus reconstructed as *CV(˙)(R)(’)(X_1)-(X_2), where X_1 is a stem-final obstruent, X_2 is an obstruent suffix, *R and *X_1 may be mutually exclusive (?, see 1.2.5), and *CV˙’ is not distinguished from *CV’ (see Krauss 1964:123-4). Note incidentally that only one obstruent suffix position is reconstructed, and that minor types (broken stems and stems with two stem-final obstruents) are not included here (see 5.1.3, 5.1.4).

A reference chart of the PA reflexes of PPA obstruent-closed stem shapes is included here. This chart shows the interaction between spirantization and constriction, and may be found useful in understanding section 3. Note especially that reduced-vowel stems are spirantized only preceding an obstruent suffix, whereas full-vowel stems are spirantized preceding an obstruent suffix, word-finally, and preceding an enclitic (see 4.5).

Table 3. Reflexes of PPA obstruent-closed stem shapes in PA

PPA Stem Shape		PA Stem Shape		
		non-spirantized	spirantized	
CvX$^-$	→	CvX$^-$	CvX̃	(only /__-X)
CvX'	→	C$\overset{,}{V}$X'	C$\overset{,}{v}$X̃	
CV·X$^-$	→	CV·X$^-$	CV·X̃	
CV·X'	→	CV·X' C$\overset{,}{V}$·X$^-$ C$\overset{,}{V}$·X'	C$\overset{,}{V}$·X̃	
CV'X$^-$	→			
CV'X'	→			

3. Stem variation in obstruent-closed roots

We will begin the discussion of Athabaskan stem variation by considering obstruent-closed roots, which have fewer stem allomorphs than non-obstruent-closed roots. These roots also illustrate the processes of spirantization and the development of constriction, showing how they mutually interact in producing stem variation in PA. In parts 3 and 4 we will consider only the behavior of _regular_ _variable_ roots, the question of invariable and irregular roots being reserved for part 5.1.

There are basically three types of variable obstruent-closed roots: (1) those having a _reduced_ perfective stem vowel, here reconstructed PPA *CvX, (2) those having a _full (long) non-constricted_ perfective stem vowel in PA, here reconstructed PPA *CV·X, and (3) those having a _full (long) constricted_ perfective stem vowel in PA, here reconstructed PPA *CV'X. These three types are separated into two subtypes each, according to whether the final obstruent is non-glottalized (X$^-$) or glottalized (X').

We will first consider stem variation in the *momentaneous*[27] stem sets of variable obstruent-closed roots. The data are summarized in the following chart of abstract PA reconstructions, with exemplary roots, where X^- represents a non-glottalized obstruent, X' represents a glottalized obstruent, and X̃ represents a spirantized obstruent. Data for these stems are given in section 3.5.

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[27] The question of *aspect*, *superaspect*, and *mode* will not be considered until the second half of this paper (morphology); however, the terminology used in this half of the paper should be mentioned briefly. The *modes* are *imperfective*, *perfective*, *optative* (called "future" in Chip. and "delayed future" in Sarcee), *future* (in some languages, *inceptive* (perfective), *progressive* (called "continuative" in Sarcee) , and/or *customary* are also considered to be modes, due to revision of the mode-aspect system). The *aspects* are defined mainly by stem sets, of which I name here the *momentaneous*, *continuative*, *distributive*, *conclusive*, *durative*, and *semelfactive*. The momentaneous, continuative, and distributive aspects are freely used with motion themes; whereas the conclusive and durative aspects are not characteristic of motion themes but of action themes. If the basic (primary) subtheme of an action theme takes the s- perfective prefix, its stem set is called *conclusive*, and if it takes the G- perfective prefix, its stem set is called *durative*. The concept of *superaspect* is not applicable to many Athabaskan languages, but some, especially among Alaskan Athabaskan languages, have *repetitive-customary*, *progressive*, *distributive-multiple*, and/or *conative* superaspects, which may occur in combination with aspects and sometimes other superaspects, and have forms for all modes. For further information, see Kari 1979 and Hardy (1979).

Table 4. PA momentaneous stem set types for obstruent-closed roots.

	Perfective	Imperf.-Optative	Future
1a.	CVX¯ (t'ɑq)	CVˑX̃ (t'aˑx̣)	CVX̃-ł (tɑx̣ł)
1b.	CV̓X' (nə̓q')	CV̓ˑX̃ (nė̓ˑx̣)	CV̓X̃-ł (nə̓x̣ł)
2a.	CVˑX¯ (ẏaˑt)	CVˑX̃ (ẏaˑt)	CVX̃-ł (ẏɑł)
2b.	CVˑX' ('aˑtš')	CV̓ˑX̃ ('a̓ˑš)	CV̓X̃-ł ('ɑ̓šł)
3a.	CV̓ˑX¯ (ni̓ˑk̭)	CVˑX̃ (niˑx̭)	CVX̃-ł (nəx̭ł)
3b.	CV̓ˑX' ('a̓ˑtł')	CV̓ˑX̃ ('a̓ˑł)	CV̓X̃-ł ('ɑ̓łł)

The greatest variety of possible stem forms is in the perfective; all the imperfective-optative stems have long vowels; all the future stems have short vowels; and in both the imperf.-opt. and the future stems the stem-final consonant is spirantized throughout. The only differences are in constriction of the vowel. We see that it is only where the perfective stem ends in a glottalized consonant that the spirantized stems have constricted vowels. Further examining the perfective stems, we see that here there are six possible stem shapes, as opposed to only two for both the imperfective-optative and the future stems. Where the perfective stem has a reduced vowel, the stem vowel is constricted only when the stem-final obstruent is glottalized, but where the perfective stem has a full vowel, both constricted and non-constricted stem vowels can be found, whether the stem-final obstruent is glottalized or not.

On the basis of this symmetrical arrangement of three pairs of perfective stem types, one with a glottalized final and one with a non-glottalized final, I have concluded that PPA had three types of vowel nuclei (v, V·, V’) and that roots which originally had a long nucleus gave rise to stem sets with long non-constricted perfective stems, whereas roots which had a glottalized nucleus gave rise to stem sets with long constricted perfective stems. The PPA roots for the above examples are therefore reconstructed as *t'aq, *nəq', *x̣a·t, *’a·tš', *ni’k, *’a’tł'.

3.1. The perfective stem

If we compare the perfective stems with the Eyak cognates, where they are found, we find stops in Eyak, not spirants, further evidence that the non-spirantized forms found in the PA perfective stem are more original than the spirantized forms found elsewhere:

PA *nəq 'fabric falls', E. ləq 'throw animate'
PA *nəq' 'swallow', E. ’ni·q' 'swallow'
PA *’a·tš' 'few go', E. ’a’tš' 'pl. go'
PA *ni̓·k 'move hand', E. le’k(^{w}) 'touch', cf. Tl. nik^w 'feel'
PA *’à·tł' 'chew', E. ’a’tł' 'chew'

Why then are the imperfective-optative and future stems spirantized, or alternatively, why did the perfective stems fail to spirantize? A clue as to the original form of the perfective stem is found in the fact that for roots ending in a fricative, the final fricative is voiced, as in the case of the root *si’ł 'become warm, sweaty', PA perf. *zi̓·l, Nav. zì·l, Sar. zìl, Chip. ðíl, Kut. γià·, Tanaina zil. But according to Krauss (1969:56), fricatives become voiced in PA when intervocalic, as attested in the alternation found in stem-initial and stem-final fricatives.

Therefore I postulate that the perfective stem failed to spirantize and stem-final fricatives were voiced because of a vocalic perfective suffix, which I have reconstructed morphophonemically as *-Ỹ.[28] This suffix had both vocalic and consonantal qualities. After open (CV) roots, it was *-Ỹ (or possible *-ỹɨ), as attested in Carrier -i and Kutchin -ɨ, but merged with *n in Ingalik, e.g. PPA *'a·-Ỹ 'classificatory compact object', PA *'a·ỹ, Car. 'ai, Kut. 'aɨ, Ing. 'oN. Following closed roots it was perhaps the vocalic counterpart of *ỹ, i.e. *-i, *-ɨ, or some similar reduced vowel.

Vocalic *-Ỹ added to obstruent-closed roots had the effect of voicing stem-final fricatives and preventing spirantization, but later dropped off, possibly already in

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[28] The perfective suffix following obstruent-closed stems is the only vocalic suffix reconstructed for verb stems (the negative *+(h)e· and the relativizers are here classified not as suffixes but as enclitics)). With noun stems, the only vocalic suffixes reconstructed are the possessive suffix *-ə' and a similar suffix *-ə. In a few fossilized possessed noun stems, usually having corresponding verb forms, spirantization is prevented by the suffix *-ə': compare Koy. x̣ənax̣ 'language', poss. x̣ənagə' (with thematized rep.cust. suffix *-k); also Hupa džew 'pitch', poss. -džewə' alongside džeq'ə' '(snail's) slime', and Tanaina Gis 'wild celery', poss. -Gits'a('), cf. -Gits' 'scale (fish)', hence 'peel (plant)', also denominal -Gits' 'crunch (as wild celery)'. In most cases, however, spirantization operates on noun roots in the possessed form if it operates in the non-possessed form. Again we see the principle that a phenomenon which operates regularly with verb stems may be optional or fossilized with regard to noun stems (see 1.3.3 and note 22).

PA, so that with modern languages, the perfective suffix is describable as a morphophoneme. In the momentaneous imperfective-optative stem, where there was no such suffix, spirantization occurred.

Thus for the momentaneous stem set, we find three stem types represented: the perfective (Pf) stem with *-Ỹ, the imperfective-optative (IO) stem with lengthening (L) and subsequent spirantization, and the future (F) stem with *-ł accompanied by vowel reduction and subsequent spirantization.

3.2 The basic stem

To get a more complete picture of the conditions under which spirantization operates, let us expand the above chart, adding the imperfective-optative(-future) (IO(F))[29] stem of the continuative stem set. The occurring continuative IO(F) stems for the previously cited roots are PA *t'ɑq, *nəq', [**ɣa·t not attested], *'ả·š, *nỉ·x̬, [**'ả·ł not attested].[30] We should also note that the momentaneous F stem is identical with the progressive stem, and that the continuative perfective stem is identical with the momentaneous perfective stem. This chart now shows the four fundamental stem variants found with regular variable obstruent-closed roots, the progressive stem exemplifying the category of obstruent-suffixed stems.

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[29] Navajo has extended the use of ł-suffixed stem to all future stems, so that the continuative future stem is identical with momentaneous future stem. This subject is left to be discussed in the next half of this paper.

[30] The data available on the continuative stem set in tone languages are deficient, being provided mainly by Navajo, and in a few cases by Chipewyan. (In Sarcee, continuative stem sets are not attested, and in Kutchin, non-reduced obstruent-final roots use the momentaneous stem set as the continuative). In particular, no roots of the shapes *CV·X¯ and *CV'X' have been reconstructed for motion themes. Although momentaneous stem sets for such roots are attested in non-motion themes, no continuative stem sets have been found which agree from language to language. The forms given in brackets are the expected forms. It should be noted, however, that a couple of irregularly low-toned continuative IO stems are found with Navajo roots which have stem variation like that expected from PPA roots of the shape *CV·X¯, for example 'roll', pf. stem má·z, mom. IO má·s, cont. IO mà·s. It thus appears that Navajo has extended the PA constricted (Nav. low-toned) vowel of the PPA root *CV·X', *CV'X¯, *CV'X' root types to the root type *CV·X¯; hence most long-voweled cont. IO stems are low-toned in Navajo, as Sapir noted.

Table 5. PA momentaneous, continuative, and progressive stem set types for obstruent-closed roots.

	PPA Root	Mom.,Cont. Perf.	Cont. IO(F)	Mom.IO	Mom.F, Prog.
1a	CvX¯	CVX¯	CVX¯	CV·X̃	CVX̃-ł
1b	CvX'	CV́X'	CV́X'	CV́·X̃	CV́X̃-ł
2a	CV·X¯	[CV·X¯]	CV·X̃	CV·X̃	CVX̃-ł
2b	CV·X'	CV·X'	CV́·X̃	CV́·X̃	CV́X̃-ł
3a	CV'X¯	CV́·X¯	CV́·X̃	CV·X̃	CVX̃-ł
3b	CV'X'	[CV́·X']	CV́·X̃	CV́·X̃	CV́X̃-ł

From the continuative IO(F) stem shapes, it can be seen that long-vowel stems undergo spirantization, whereas the reduced-vowel stems do not.

Likewise, long-vowel stems ending in a fricative do not undergo voicing of the final fricative, whereas the final fricative of reduced-vowel stems becomes voiced in the continuative IO(F) stem. Hence we may make the following observation with regard to *CV̲S roots: under the same conditions where *CV̲T roots fail to spirantize, the final spirant of *CV̲S roots is voiced.

Hence in the above chart, final PA *X̃ is the only source of voiceless final fricatives; final PA *X¯ is voiced if an original fricative. Thus the final voicing, when considered by itself as a phonological rule (1.3.3), seems anomalous; but in the context of the continuative IO(F) stem, we see that voicing serves to distinguish the non-spirantized from the spirantized stem for *CvS roots.

The continuative IO(F) stem, then, could not have had an obstruent suffix, in which case it would behave like the progressive stem (always short and spirantized); nor could it have had a vocalic suffix, in which case it would behave like the perfective stem (never spirantized). I call this the basic stem, and posit that it was identical with the unsuffixed root in PPA (this can be seen also in the case of open roots, see 4.1). From the above discussion it becomes apparent that spirantization operated (1) on stems having full vowels not followed by a suffix, and (2) on stems followed by an obstruent suffix, such as the progressive suffix *-ł.

3.3 The lengthened stem

It can be seen from the above chart that the mom. IO stems of all variable roots, regardless of their original vowel grade (*CvX, *CV˙X, *CV'X) have long vowels, and are spirantized. I therefore call this the lengthened stem, where v, V'> V˙. Lengthened stems are also found in Eyak (Krauss 1965:181-2, called the 'expanded' stem) and Tlingit. Furthermore, both languages have a class of active themes characterized by a lengthened imperfective stem. In Tlingit, variable roots take the lengthened stem in the future and other tenses, and in Eyak the persistive and customary stems are lengthened. This evidence indicates that lengthening was a productive process in Na-Dene, and I posit lengthening as a morphological process in PPA.[31]

Note that the basic and lengthened stems of *CV·X¯ roots are not distinguishable in PPA, e.g. *x̣a·t could be either a basic or a lengthened stem for 'shake (out)', and similarly with *'a·tš' 'a few go' (see 3.5.3-4). Furthermore, the fact that PPA *CV'X' and *CV·X' both spirantize to PA *CV̓·X̃ makes it impossible to tell the basic and lengthened stems apart for PPA *CV'X' roots (see 3.5.6). Thus, of the full-vowel nucleus types, only *CV'X¯ has a basic stem which is still distinct from the lengthened stem in PA.[32]

In reduced-vowel roots, PPA *a lengthens to *a·; *ủ lengthens to *u·; and *ə (< PA *ʋ next to a labialized obstruent) lengthens either to *i· or *e·.[33] In most cases, the lengthened vowel is predictable by the rule that *ə lengthens to *e· adjacent to a *uvular* consonant, otherwise to *i·.[34] In some cases, however, *ə not adjacent to a uvular lengthens to *e·.[35]

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[31] In Hupa and Mattole (and possibly PCA in general), special lengthened stems are apparently found only from long roots ending in a glottalized obstruent (see 3.5.4 and 3.5.6). Note also that the PA lengthened stem vowel is actually reduced in Hupa and Mattole. Such reduction is found in other stems e.g. in the momentaneous imperfective stem, Hupa təW 'sing. lie', Mattole ti̱x PA *tẻ·x PPA *te'-x. Since the momentaneous future stem of obstruent-closed roots is identical with that of the momentaneous IO stem, except for the addition of -ł in the future stem, it seems likely that the reduced vowel of the future stem was extended to the IO, thus simplifying stem variation. Two generalizations are useful: (1) originally reduced-voweled roots, as well as long-voweled roots ending in a non-glottalized obstruent, do not have special lengthened stems in PCA, and (2) some long-voweled roots are invariably full-vowel in PCA, even when reduction is expected, e.g. k̭os 'handle fabric', future k̭osəł, but PA *k̭əs-ł.

[32] This fact raises theoretical difficulties in assigning aspect to themes of these root types, which will be discussed in the following half of this paper.

3.4 The obstruent-suffixed stems

The remaining stems are formed by the addition of obstruent suffixes to the root. Variable obstruent-closed stems are reduced before an obstruent suffix, as in the momentaneous F stems given above (see Krauss 1964:122).[36] This rule operates quite regularly in Athabaskan. Furthermore, the fact that the same rule is found in Tlingit, and that there are a couple of cases in Eyak where obstruent-suffixed stems are reduced, strongly suggests that this rule was operative in Proto-Na-Dene. Therefore, I posit this as a morphophonemic rule in PPA, and not an innovation.

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[33] In addition to the lengthened stem discussed above, Aht., Tanaina, Ingalik and Koy. have what appears to be an innovative lengthened stem, here called the *expanded* stem, used as the customary stem of invariable stem sets in Aht. and Tanaina, as a multiple ('one after the other') and mode-marked neuter stem in some Tanaina as well as Ingalik and Koy., and as a mode-marked neuter stem in Koy. This stem is formed by changing the root vowels ə, e, i to i; ɑ, a to a; ʋ, u to u, regardless of their source in PPA. Thus for example from PPA *gut > PA *g̑ət, 'fear', the expanded stem is Koy. (act. neut.) git, Aht. (cust.) gi·t, cf. the historical lengthened (mom. IO) stem PPA *gu·t, PA *g̑u·t, Koy. gut, Aht. gu·t. See also Kari 1979:3.3.1.2 and section 4.

[34] In fact, other than PA *ɨ· < PPA *VN (by nasalization), the vowel *i· is rarely found adjacent to a uvular consonant. This is probably due to an early rule of vowel lowering next to a uvular. Such rules are found in many languages having uvulars, including most Northern Tlingit. Such a vowel lowering rule would also explain the otherwise anomalous ablaut found in *ni 'become (thus)', PA IO *ne·x̣, fut. *ni·ł.

[35] The most common roots for which *ə expands irregularly to *e· are *tsəx 'poke with stick', *tsəs 'fire goes out', and *t'ɔk' or (Alaskan) *k'ət' 'ropelike obj. extends'. These may be survivals from an early stage of Athabaskan (or Na-Dene) where short *i and *e were distinct.

[36] Reduction does not occur, however, with invariable roots (see 5.1.2).

$\left\{\begin{matrix} \mathrm{V}^{\cdot} \\ \mathrm{V}' \end{matrix}\right\} >$ v/__X-X in variable obstruent-closed stems.

The productive obstruent suffixes are here reconstructed as PPA *-ɬ, *-x̣, *-k, *-x, *-t. (Note that *-k and *-x are *front velars*.) In most cases, consonant clusters resulting from the addition of these suffixes to obstruent-closed roots have been simplified in modern Athabaskan languages by dropping the second member, unless the first member is root-final *t, which regularly drops out before *-ɬ and *-k (see 3.5.1, 3.5.3). The fact that the suffix was dropped makes it difficult in some cases to tell which of the obstruent suffixes was originally present. Furthermore, the original forms of the semelfactive suffixes here reconstructed as *-x and *-t are not certain and have been posited on indirect evidence, since these suffixes occur only with obstruent-closed roots, and are dropped in most Athabaskan languages.

It is, however, possible to tell whether or not a given stem of an obstruent-closed root originally had an obstruent suffix in languages like Navajo, which consistently preserve a contrast between voiced and voiceless stem-final fricatives, but on the other hand, change final affricates to voiced fricatives. Stems of variable obstruent-closed roots which had an obstruent suffix are reduced and end with *voiceless* fricatives, whereas stems which had no obstruent suffix end with _voiced_ fricatives if they are reduced (see 1.3.3). It is quite important to keep this in mind when applying this theory to a specific Athabaskan language. Thus for example the Navajo future, customary, and semelfactive stem žīš 'suck in, inhale' reflects originally obstruent-suffixed stems, whereas the other stem žīž reflects a non-obstruent-suffixed stem.

Following are discussions of the productive suffixes individually.

3.4.1 *-ł (progressive, negative perfective)

The progressive, future (sometimes also optative) and negative perfective suffix *-ł occurs overtly after open stems, and is kept as -tł when it is the second member of a cluster in Koyukon and formerly in Kutchin, e.g. PPA 'atš'ł 'a few go' prog., PA *'a̓šł, Koy. 'ɑstł, Kut. 'ȁl (< *'ɑtł < *'ɑstł). In other languages, *-ł is dropped after an obstruent (except sometimes in Sarcee and Chipewyan, and regularly in Kutchin, where *x̣ł > *hł > ł, see ex. 3.5.5).[37] Note that roots ending in PA *t (< PPA *t, t') drop final *t before the suffix -ł: compare PPA *tł'i·t' 'pl. fall', mom. fut. *tł'ət'-ł > *tł'ə̓t-ł (by spirantization) > PA *tł'ə̓ł, Chip. tł'ɛ́ł, Kut. tł'ȁ·. Roots ending in PA *ł spirantized from PPA laterals, apparently also optionally contract *łł to *ł, compare for example PPA *'atł'-ł 'chew' prog., PA *'ɑ̓łł or 'ɑ̓ł, Koy. 'ɑłtł or 'ɑł, Hupa 'əłəł or 'ə̓ł, and Kutchin 'ȁ· (< *'ə̏ł, not **'ə̏łtł). This contraction may be a late rule, as shown by the Koy. negative perfective stem 'ɑłdlá (< PA *'ɑ̀łłe·, not **'ɑ̀łe·, see 4.5).

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[37] In Hupa, but not in Mattole, -əł is suffixed to closed roots. This variant of the *-ł suffix is probably a late addition by analogy with open roots.

The suffix *-ł is cognate with the Eyak progressive suffix -ł, and perhaps also the Tlingit progressive and positional suffix -ṅ.

3.4.2 *-x̣ (reversative)

The reversative suffix *-x̣ also occurs overtly after open stems, but is nowhere found overtly after obstruent-closed roots; its only trace is reduction and spirantization. Compare (P)PA *'a·-x̣ 'classif. compact object' revers., Nav. 'á·h, Kut. 'é·, Koy. 'ox̣, Aht. 'a·x̣; and PPA *dəțł'-x̣ 'throw pl. objects' revers., PA *də̓ł(-x̣), Nav. dìł, Koy. dəł, Aht. deł.

Both Eyak and Tlingit have -x̣ suffixes. In Eyak this is the 'progressive' suffix (Krauss 1965b) used mainly with the preverb yəx̣ and denoting either random motion ('going about') or, particularly, with the compound preverb q'e·yəx̣, reversal of motion. In Tlingit, -x̣ is one of the repetitive-customary suffixes.[38]

3.4.3 *-k (repetitive-customary)

The repetitive-customary suffix PPA *-k > PA *-k̭ is spirantized to a reflex of *-x̭ at the end of non-obstruent-closed stems in most languages, but there is no doubt that it was originally *-k, as it is in Eyak and Tlingit. In PA, however, it is reconstructed as *-k̭ ~ *-x̭. Kutchin has not spirantized this suffix, still -k in this position. In Sarcee, it is sometimes spirantized to -š, but most often appears as -tš. Even in languages where this suffix is spirantized, such as the majority of Alaskan languages, it appears as -g when followed by a reflex of the negative enclitic *+(h)e˙. In Tanaina and Koyukon, the imperfective customary stem is spirantized, but the perfective and future customary stems appear with -k. Note also that when root-final *t is dropped before *-k, the suffix *-k is never spirantized, just as original root-final *k is not spirantized in the basic stem of roots having reduced vowels: compare PPA *nək 'tell (story)' (basic stem), PA *nək̯, Nav. nì', Chip. nìy, Car. nək, Kut. ndák, Koy. nək; and PPA *sət-k 'time elapses' rep.-cust., PA *zək̯, Nav. zì', Chip. ðìy, Car. zək, Kut. ðák, Koy. lək. In contrast, the suffixes *-ł and *-x̣ were always spirants.

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[38] Note also that in Aht. and Tanaina, -x̣ is used as a rep.-cust. suffix following the L' stem of non-obstruent-closed roots (see the L'-X stems of the examples in 4.6).

Note also that -k is also common to Eyak and Tlingit as a repetitive suffix.

3.4.4 *-x (semelfactive non-perfective)

The semelfactive suffix PPA *-x > PA *-x̯ shares several phonological peculiarities with *-k. In Chipewyan, both have an i-effect on the reduced vowel of the stem: e > i, a > ai, o > u (see 1.2.3) with both rep.-cust. and semelfactive non-perf. stems, which shows that both these suffixes were palatals (articulated with high tongue position) and had an assimilating effect on the stem vowel before they were dropped. Furthermore, both these suffixes contract with root-final *-t in Chipewyan and Kutchin, resulting in *-k: *t-$\left\{\begin{array}{c}\text{k̯}\\ \text{x̯}\end{array}\right\}$ > *k̯; e.g. from PPA

*G^{W}e't 'poke, dig', semel. non-perf. *G^{W}ət-x, PA *Gʋtx̭, Chip. gùi = gùy (< *Gʋk̭) , Kut. gók, but Nav. gòd. Finally, in both Kutchin and Koyukon there occurs a unique metathesis of the PA consonant cluster *łk̭ or *łx̭, where *-k̭ ~ *-x̭ is the repetitive-customary suffix: *łk ~ *łx̭ > x̭tł, e.g. from PPA *'a'tł' 'chew', rep.-cust. *'atł'k, PA *'ɑ̇łk̭ or 'ɑ̇łx̭, Koy. 'ɑx̭tł, Kut. 'ɑ̀l < *'ɑ̀tł < *'ɑ̀x̭tł.[39] In Kutchin, the first member of the cluster is dropped, leaving tł, which regularly becomes -l verb-stem-finally. In Kutchin, but not in Koyukon, the cluster *łx̭, where *-x̭ is the semelfactive suffix, follows the same development, so that the semelfactive non-perfective stem for *'a'tł' 'chew' in Kutchin is homophonous with the repetitive-customary stem, 'ɑ̀l (< *'ɑ̀x̭tł), but in Koyukon it is 'ɑł. This evidence is rather conclusive proof that the semelfactive suffix was a front velar.

However, the suffix *-x does not always produce the same reflexes as *-k. In Koyukon, Sarcee, and Navajo, stem-final t contracts with the suffix *-k as described above, but in semelfactive stems the suffix *-x does not; there is no trace of it other than reduction of the stem vowel and spirantization of stem-final obstruents as described in 3.4. (In Tanaina and Ahtna, both the suffixes *-k and *-x drop after stem-final t.) Furthermore, whereas the suffix *-k metathesizes with root-final *ł in Koyukon, yielding x̭tł, as shown above, the suffix *-x drops after *ł in Koyukon.

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[39] This same metathesis is attested in Chilcotin (Krauss, from data personally communicated by Quindel King and E. D. Cook).

This evolution of consonant clusters is to be dated after PA times, since consonant cluster reduction is ordered after spirantization, and is specific to groups of daughter languages. In any case, it is highly unlikely that the semelfactive suffix was the same as the rep.-cust. suffix *-k; otherwise there would be no phonological grounds for the difference found in the development of these consonant clusters. There are only two other front velar consonants which could occur syllable-finally, namely *k' and *x. Since it seems unlikely that *k' would behave differently from *k in consonant clusters, and since *k' could have had the effect of constricting the stem vowel (which does not occur with semelfactive stems), the most likely candidate for the semelfactive suffix is *-x.

One more consideration needs to be taken into account with regard to the identity of the semelfactive suffix. The momentaneous imperfective stem of most non-obstruent-closed roots has the suffix PPA *-x, PA *-x̭; for example, compare root *ʾa 'classif. sg. compact object', mom. impf. PPA *'a'-x, PA *'ả·x̭, Nav. 'ȁ·h, Sar. 'ȍh, Chip. 'áih, Kut. 'ȁi·, Koy. 'ox̭, Aht. 'a·s, Hupa 'ɑW, Matt. 'a·x. This suffix is not a spirantized form of the repetitive suffix *-k, since in Kutchin this suffix is -i (< *-x̭) and not -k, and in Sarcee this suffix is -ih (< *-x̭) and not -(t)š. Compare Sarcee 'ȍh and Kutchin 'ȁi 'classif. compact object' mom. imperf. with the rep.-cust. stems Sarcee 'ō̏tš ('ótš expected), Kutchin 'ák. Moreover, in Koyukon this suffix appears as -y before the negative enclitic, and not -g like the repetitive-customary suffix. In most languages, however, the two suffixes are identical in form in all cases. As will be pointed out in the second half of this paper, it seems plausible to assume that this suffix *-x is identical in origin with the semelfactive suffix.

3.4.5 *-t (semelfactive perfective)

There is more concrete evidence for the identity of the t-suffixed semelfactive perfective stem. This suffix actually occurs as the semelfactive suffix in Sarcee, recorded by Sapir especially for the semelfactive perfective stem, e.g. from PPA *dəts 'spin (rope)', Sarcee semelfactive imperfective dīs < *dəsx̣̭, perfective dīst < *dəst. In fact, Sarcee provides the only attested examples of PA consonant clusters ending in -t.

Kutchin and Chipewyan also provide circumstantial evidence that the semelfactive perfective stem had an obstruent suffix which was not identical with the semelfactive non-perfective suffix *-x. The i-effect on the stem vowel does not occur with the semelfactive perfective stem in Chipewyan; the contraction *t-k > *k does not occur with the semelfactive perfective stem in either Kutchin or Chipewyan, and in Kutchin stems which have reflexes of metathesized *łx̣̭ clusters in the semelfactive non-perfective stem show reflexes of *ł in the semelfactive perfective stem. Compare, for example, the semelfactive stem sets of 'poke': Chip. IO gùih [gùy], pf. gòr, Kut. IOF gók, pf. gót; and 'chew': Chip. IO 'áił, Pf. 'áł, Kut. IOF 'àl (<*'ə̀x̣̭tł), Pf. 'à· (< *'ə̀ł). All languages, however, attest to the fact that there was an obstruent suffix, since there is stem vowel reduction and spirantization of final obstruents.

In Alaskan Athabaskan languages, Carrier, and Navajo, the suffix *-t is also added to s-transitional perfective stems of some non-obstruent-closed roots.

3.4.6 Other obstruent suffixes

Other obstruent suffixes are very rarely attested in Athabaskan. In fact, only one clear example of an obstruent suffix other than the above is found, *-ts', in the stem set of the root *t'aỹ (?) 'become roasted', whose Pf stem is PPA *t'aỹ-Ỹ (?) > PA *t'e·, and whose IOF stem is PPA *t'aỹ-ts' (?) > PA *t'e̓·s. Interestingly enough, the Tlingit cognate t'a 'become hot', nominal form t'aˋy̲ 'heat', has an imperfective stem t'eˋs', with suffixed -s' (a common imperfective suffix in Tlingit).

3.5 Examples of variable obstruent-closed roots

For the languages included in this study, it appears that all stem variation in variable obstruent-closed roots can be accounted for by the four stem types thus far discussed:[40] the basic stem (represented by the continuative IO(F) stem); the perfective stem, identical with the basic stem but having a vocalic suffix (*-Ỹ); the lengthened stem (represented by the momentaneous IO stem); and the obstruent-suffixed stems (represented by the progressive IO stem), which are all characterized by stem vowel reduction. The PPA and PA reconstructions of these stems for each of the variable obstruent-closed root types is summarized in the following chart:

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[40] Exceptions are discussed in 5.1.

Table 6. PPA and PA stem variation for obstruent-closed roots.

		Perfective	Basic	Lengthened	Obstruent-suffixed
1a.	PPA	CvX¯-Ỹ	CvX¯	CV˙X¯	CvX¯-X
	PA	CvX¯	CvX¯	CV˙X̃	CvX̃X
1b.	PPA	CvX'-Ỹ	CvX'	CV˙X'	CvX'-X
	PA	Cv̇X'	Cv̇X'	CV̇˙X̃	Cv̇X̃X
2a.	PPA	CV˙X¯-Ỹ	CV˙X¯	CV˙X¯	CvX¯-X
	PA	CV˙X¯	CV˙X̃	CV˙X̃	CvX̃X
2b.	PPA	CV˙X'-Ỹ	CV˙X'	CV˙X'	CvX'-X
	PA	CV˙X'	CV̇˙X̃	CV̇˙X̃	Cv̇X̃X
3a.	PPA	CV'X¯-Ỹ	CV'X¯	CV˙X¯	CvX¯-X
	PA	CV̇˙X¯	CV̇˙X̃	CV˙X̃	CvX̃X
3b.	PPA	CV'X'-Ỹ	CV'X'	CV˙X'	CvX'-X
	PA	CV̇˙X'	CV̇˙X̃	CV̇˙X̃	Cv̇X̃X

Following are representative examples of stem variation as attested for each of the six variable obstruent-closed root types. In cases where the Sarcee stem tones given in the stem list disagree with the expected tones, I give the vowel with the expected tone in brackets. Some of Morice's data are likewise questioned.

3.5.1. *t'aq 'fly'

perf. stem: PPA *t'aq-Ỹ, PA *t'αq, Nav. t'à', Sar. t'òy~t'òg-[ō], Car. t'o (< *təɣ̇), Kut. t'ák, Koy. t'αq, Aht. t'aq, Hupa t'αw.

basic (cont. IO(F)) stem: PPA *t'aq, PA *t'αq, Nav. t'à', Car. t'o, Kut. t'ák, Koy. t'αq, Aht. t'aq.

lengthened (mom. IO) stem: PPA *t'a·q, PA *t'a·x̣, Nav. t'á·h, Sar. t'óh, Chip. t'à, Car. t'ah, Kut. t'í·, Koy. t'ox̣, Aht. t'a·x̣, Hupa t'αw.

**-ł (prog., mom. F) stem*: PPA *t'aq-ł, PA *t'αx̣ł, Nav. t'àh, Sar. t'òh [ō], Car. t'əx̣, Kut. t'á· (<*t'əٰł< *t'əٰx̣ł) Koy. t'αx̣tł, Aht. t'ax̣, Hupa t'αwəł.

**-k (rep.-cust.) stem*: PPA *t'aq-k, PA *t'αx̣k̯̣ or *t'αx̣x̯̣, Nav. t'àh, Sar. t'òtš [ō], Car. t'əx̣, Kut. t'é· (< *t'ə́x̣), Koy. t'αx̣, Aht. t'ax̣.

With the above, compare PPA *nəq 'fabric (or animate) falls', Eyak ləq 'throw animate', PPA lengthened stem *ne·q, Eyak expanded stem le·q as in cust. le·q-k', PPA prog. stem *nəq-ł, Eyak ləq-ł, PPA rep.-cust. stem *nəq-k, Eyak. ləq-k.

3.5.2. *nəq' 'swallow'

perf. stem: PPA *nəq'-Ỹ, PA *nə̉q', Nav. nȁ', Sar. nȉk', Chip. náɣ, Car. no, Kut. ndȁk, Koy. nəq, Aht. na', Hupa nəq'.

basic (cont. IO(F)) stem: PPA *nəq', PA *nə̉q', Koy. nəq.

lengthened (mom. IO) stem: PPA *ne·q', PA *nẻ·x̣, Nav. nȅ·h, Sar. nȁh, Chip. nέ, Car. neh, Kut. ndžȉ·, Koy. nax̣, Aht. ne·x̣, Hupa nəw.

*-ł (prog., mom. F) stem: PPA *nəq'-ł, PA *nə̉x̣ł, Nav. nȁh, Sar. nȉh~nȉł, Car. nəx̣, Kut. ndȁ· (< *ndə̏(x̣)tł, Koy. nəx̣tł, Aht. nax̣, Hupa nəwəł.

*-k (rep.-cust.) stem: PPA *nəq'-k, PA nə̉x̣k̯ or nə̉x̣x̯, Nav. nȁh, Sar. nȉtš, Chip. náih, Car. nəx̣, Kut. ndȅ· (< *ndə̏x̣), Koy. nəx̣, Aht. nax̣.

3.5.3. *x̣a·t 'shake (out)'

perf. stem: PPA *x̣a·t-Ỹ, PA *ɣ̇a·t, Nav. ɣá·d, Sar. ɣó'(d-), Chip. ɣȁr, Car. ɣat, Kut. ɣát, Koy. ɣot; Aht. ɣa·t, Hupa wad.

lengthened (mom. or dur. IO(F)[41]) stem: PPA *x̣a·t, PA *ɣ̇a·t, Nav. ɣá·t, Sar.ɣó'(d-), Chip. ɣȁr, Car. ɣat, Kut. ɣát, Koy. ɣot, Aht. ɣa·t, Hupa wad.

*-ł (prog., mom. F) stem: PPA *x̣at-ł, PA *ɣ̇ɑł, Nav. ɣȁł, Car. ɣəł, Koy. ɣɑł, Aht. ɣał, [Hupa wadəł or wał (?)].

*-k (rep.-cust.) stem: PPA *x̣at-k, PA *ɣ̇ɑk̭, Nav. ɣȁ', Car. ɣək, Kut. ɣák, Koy. ɣɑk, Aht. ɣat.

*-x (semel. non-perf.) stem: PPA *x̣at-x, PA *ɣ̇ɑtx̯, Nav. ɣȁd, Chip. ɣȁy (< *ɣɑ̀k̯), Aht. ɣat.

*-t (semel. perf.) stem: PPA *x̣at-t, PA *ɣ̇ɑtt, Nav. ɣȁd, Chip. ɣȁr.

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[41] For an explanation of "durative" see note 27 and Kari 1979. Note that, as with *'a'tł' (3.5.6) the basic and lengthened stems of *x̣a·t are not distinguishable (see 3.3).

3.5.4 *'a·tš' 'few go', with ł- 'pl. animals go'

perf. stem: PPA *'a·tš'-Ỹ, PA *'a·tš', Nav. 'á·ž, Sar. 'óz ~'ódz-, Chip. 'ȁz, Car. 'az, Kut. 'ó·, Koy. 'ots, Aht. 'a·ts', Hupa 'atš'.

basic (cont. IO(F)) stem: PPA *'a·tš', PA *'ả·š, Nav. 'ȁ·š, Chip. 'ás, Car. 'as, Koy. 'os, Aht. 'a·s; Eyak 'a'tš'.

lengthened (mom. IO) stem: PPA *'a·tš', PA *'ả·š, Nav. 'ȁ·š, Sar. 'ȍs, Chip. 'ás, Car. 'as, Kut. 'ȍ·, Koy. 'os, Aht. 'a·s, Hupa 'ɑW; Eyak expanded stem 'a·tš'.

**-ł (prog., mom.F) stem*: PPA *'atš'-ł, PA *'ɑ̉šł, Nav. 'ȁš, Sar. 'ȍs, Chip. 'ás, Car. 'əs, Kut. 'ȁl (<*'ə̏stł), Koy. 'ɑstł, Aht. 'as, Hupa 'ɑWəł; Eyak prog. 'a'tš'-ł.

**-k (rep.-cust.) stem*: PPA *'atš'-k, PA *'ɑ̉šk̯ or *'ɑ̉šx̯, Nav. 'ȁš, Sar. 'ȍš, Chip. 'áis, Car. 'əs, Kut. 'ȍ· (< *'ə̏s), Koy. 'ɑs, Aht. 'as; Eyak rep. 'a'tš'-k.

**-x̣ (rev.) stem*: PPA *'atš'-x̣, PA *'ɑ̉š(-x̣), Koy. 'ɑs, Aht. 'as.

3.5.5 *ṅi'k 'move hand'

perf. stem: PPA *ni'k-Ỹ, PA *ni̓·k, Nav. nì·', Sar. nìž~nìdž-, Chip. ní(y) ('handle', 'buy'), Car. nik, Kut. ndžìk, Koy. nik, Aht. ni·k, Hupa nəĝ, Mattole ni̲d.

basic (cont. IO(F)) stem: PPA *ni'k, PA *ni̓·x̯, Nav. nì·h, Sar. nì' (? 'make an offering, pay'), Chip. níy ('handle, treat'), Car. nih, Koy. nix̯, Aht. ni·s; cf. Eyak le'k(^{w}), Tlingit niˋkw 'feel'.

lengthened (mom. IO) stem: PPA *ni·k, PA *ni·x̯, Nav. ní·h, Sar. níh, Chip. nì(h), Car. nih, Kut. ndží·, Koy. nix̯, Aht. ni·s, Hupa nəĝ, Mattole ni̲x; cf. Eyak le·k, Tl. ni·kw.

*-ł (prog., mom. F) stem: PPA *nək-ł, PA *nəx̯ł, Nav. nìh, Sar. nìh [ī], Chip. nìł, Car. nih (< *nəx̯), Kut. ndál (<*ndə́x̯tł), Koy. nəx̯tł, Aht. nes, Hupa nəĝəł; Eyak prog. le'k-ł, Tl. prog. nikw < *nik^{w}-N.

*-k (rep.-cust.) stem: PPA*nək-k, PA*nəx̯k̯ or*nəx̯(x̯), Nav. nìh, Sar. nìš [ī], Car. nih, Kut. ndái·, Koy. nəx̯, Aht. nes; Eyak rep. le'k-k (but also reduced łukk < *ł-lək^{w}-k), Tl. nikw-k.

3.5.6. *'a'tł' 'chew'

perf. stem: PPA *'a'tł'-Ỹ, PA *'ả·tł', Nav. 'ȁ·l, Sar. 'ȍl, Chip. 'ál, Car. 'al, Kut. 'ȁl, Koy. 'otł, Aht. 'a·tł', Hupa 'atł'.

lengthened (mom. or dur. IO) stem: PPA *'a·tł', PA *'ả·ł, Nav. 'ȁ·ł, Sar. 'ȍł, Chip. 'áł, Car. 'ał, Kut. 'ȁ·, Aht. 'a·ł, Hupa 'ɑł.

*-ł (prog., mom.F) stem: PPA *'atł'-ł, PA *'ɑ̉ł(ł), Nav. 'ȁł, Chip. 'áł, Car. 'əł, Kut. 'ȁ· (<*'ə̀ł), Koy. 'ɑłtł~'ɑł, Aht. 'ał, Hupa 'ɑłəł~ 'ɑł.

*-k (rep.-cust.) stem: PPA *'atł'-k, PA *'ɑ̉łk̯ or *'ɑ̉łx̯, Nav. 'ȁł, Chip. 'áił, Car. 'əł, Kut. 'ȁl (< *'ə̏tł < *'ə̏x̯tł), Koy. 'ɑx̯tł, Aht. 'ał.

*-x (semel. non-perf.) stem: PPA *'atł'-x, PA *'ɑ̉łx̯, Nav. 'ȁł, Chip. 'áił, Car. 'əł, Kut. 'ȁl (as in *-k stem), Koy. 'ɑł, Aht. 'ał.

*-t (semel. perf.) stem: PPA *'atł'-t, PA *'ɑ̉ł(t), Nav. 'ȁł, Chip. 'áł, Car. 'əł, Kut. 'ȁ· (< *'ə̏ł), Koy. 'ɑł, Aht. 'ał.

4. Stem variation in non-obstruent-closed roots

In Athabaskan, to a much greater degree than Eyak and Tlingit, non-obstruent-closed (here abbreviated CV(R)) stem variation differs from obstruent-closed (CVX) stem variation, in that the structure of verb stem variation is more transparent, in that there are a greater number of possible stems, and in that with certain stems, consonant suffixes are added to CV(R) roots but not to CVX roots. Another important difference between CV(R) and CVX stem variation is that whereas with CVX roots the imperfective and the optative stems of a given stem set are everywhere identical (with some apparent exceptions in Navajo), these two stems often differ with CV(R) roots. Before considering CV(R) stem variation, let us take another look at canonical non-suffixed stem shapes (other than broken and CVXX stems) as they are reconstructed for PPA, in view of what has been said above:

Table 7. PPA canonical non-suffixed stem shapes.

	without glottal stop		with glottal stop	
	reduced	full	reduced	full
non-obstr.-closed (CV(R))				
non-closed	---	CV·	---	CV'
sonorant-closed	CvR	CV·R	CvR'	CV·R'
obstruent-closed (CVX)	CvX	CV·X	---	CV'X

Note that the gaps on the above chart follow from the distribution of full and reduced vowels in PPA: reduced vowels may not occur before *# or *H̲; and full vowels must be followed by *· or *'. The above demonstrates that sonorant-closed roots have a greater variety of stems, because all four combinations of length and glottalization occur. Note also the position of the glottal modification--it precedes an obstruent but follows a sonorant. Although sonorant-closed roots resemble CV̲X roots in some aspects of stem variation, in general, stem variation of open and sonorant-closed roots may best be considered together.

Although CV̲(R) roots may have shapes corresponding to all the above CV̲(R) syllable types, only non-glottal-final roots i.e. those of the shapes *CV· (here represented *CV and termed open), *CVR, and *CV·R are productive variable root types. With the interesting exceptions of *tš^{w}a·n' 'defecate' which has a reduced basic stem, and *q'ay' 'spread legs'[42], which has a lengthened mom. IO stem, all of the relatively few CV̲(R)' roots (*CV',*CVR',*CV·R') reconstructible for PPA are invariable; that is, they may take obstruent suffixes but do not vary with respect to length and glottalization (see 5.1.2).

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[42] The root *q'ay' 'spread legs' is a perhaps unique survival of a variable *CvR' root; but note that in all languages preserving a special lengthened stem that the forms reflect *q'a·x̣̭, as if from root *q'ax. This shows the confusion between *y and *ʕ̂ that was probably occurring in PA (see 1.2.2): PPA perf. q'ay'(-Ỹ), lengthened (mom. IO) q'a·y', PA (perf./lengthened) q'ay'/q'a·x̣̭ (or q'ả·x̣̭?), Nav. k'ȁi'/k'áih (? = k'a·ih), Sar. k'ȍy/k'ȍh̭, Car. k'əî'(? Morice ḳei)/k'aih 'hobble, limp, sit astride', Kut. k'ai' (invar.), Hupa q'ay' (invar). For more examples of roots of the type *CV̲y' see 5.1.5.

In Ahtna there are a few roots of the type *Cvn' which have a (uniquely unsuffixed) lengthened mom. IO stem, e.g. t'on' 'hop', mom. t'u·n' (Kari, 1979:3.3.1).

Whereas CV̲X roots have only two distinct non-suffixed stem variants, the basic (B) stem and the lengthened (L) stem, CV̲(R) roots may have four non-suffixed stem variants. Two variants, one with final glottal stop and one without, correspond to the basic stem of CV̲X roots, and two, similarly, to the lengthened stem of CV̲X roots. With *CV·R roots (here exemplified by *'e·n 'do (thus), see'), each of these stems has a distinctive form.

The process of stem derivation for PPA variable CV̲(R) roots is thus expressible in terms of three components: lengthening, glottalization, and suffix. Lengthening and glottalization are here considered to be superimposed on the stem, rather than added to the stem as suffixes are. Hence:

-length -glott. ⟶ non-glottalized basic (B)
-length +glott. ⟶ glottalized basic (B')
+length -glott. ⟶ non-glottalized lengthened (L)
+length +glott. ⟶ glottalized lengthened (L')

The remaining stems are formed from these four simple stem variants by the addition of the perfective suffix *-Ỹ and the obstruent suffixes (-X). There are, however, conspicuous gaps among the possible combinations, including B'-Ỹ, L-Ỹ, and L-X stems.

4.1 Basic stems

To the basic stem of CV̲X roots correspond the non-glottalized basic (B) stem, represented by the continuative I(OF) stem (PPA, PA *’ən); and the glottalized basic (B’) stem, represented only by the distributive I(OF) stem (PPA, PA *’ən’).[43]

All varieties of the basic stem (see also 4.3, 4.4) except the basic perfective stem undergo reduction in the case of variable *CVˑR roots, as well as in the case of the unique variable *CVˑR’ root *tš^{w}aˑn’ 'defecate', whose basic stem is PPA *tš^{w}an’, PA *tš^{w}ən’. This root, as well as a few *CVˑn roots such as *taˑn 'classif. sticklike obj.' (4.6.3), basic stem PPA *tan, PA *tən, show the shift *a > *ə /___n(’) in the basic stem. Since ablaut results only from the contraction of reduced vowel plus final sonorant, the basic stem (suffixed or non-suffixed, see 4.4) is the only source of PA ablaut. Thus for example PPA *ł-haˑy 'classif. pl. object' is reduced only in the basic stems PPA *ł-hay > PA *leˑ (B), and PPA *ł-hay’ > PA *le’ (B’), as well as their obstruent-suffixed counterparts (see 4.4).

The basic perfective stem, as remarked above, does not undergo reduction; neither does it undergo lengthening. Hence, the basic perfective stem minus the suffix *-Ỹ is here considered to be identical with the root.

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[43] The Hupa customary stem of CV(R) roots seems to be partially derived from the PA B’ (distributive) stem. According to Golla (1973:33), the customary stem variant "is identical with the imperfective variant unless that ends in n or a vowel, in which case ’ is added and a long stem vowel is replaced by its short counterpart " (emphasis added). Compare Hupa tšə’ (= tše’) 'make sg. obj.' cust. with the PA distrib. stem *tši’, Nav. tšì’, Chip. tsí, Koy. tsi’, Aht, tse’; note also Hupa reduced and glottalized wɑn’, cust. of wan 'kill pl.'.

4.2 Lengthened stems

To the lengthened stem of CV̲X roots correspond the *non-glottalized lengthened* (L) stem, represented solely by the durative imperfective stem (PPA, PA *'e·n); and the *glottalized lengthened* (L') stem, represented by the durative and neuter (stative) perfective and optative stems (PPA, PA *'e·n')[44,45].

The vowels of *CV·R roots, being long, do not change in the lengthened stem. With *CvR roots, *ə lengthens to *i·, *a (PA *ɑ) to a·, and *u (PA *ʊ) to u·.

Lengthened stems of CV̲(R) roots do not reduce, even when followed by an obstruent suffix (see for example the L'-X stems of 4.6.4 and 4.6.5). In the case of open roots, there is no possibility of contrast between lengthened and non-lengthened stem vowels; hence B and L stems both have the shape *CV·, and B' and L' stems both have the shape *CV'. Note also that non-glottalized L stems are not attested for the relatively small class of *CvR roots, nor for ablauting roots.

4.3. Perfective stems

Corresponding to the perfective stem of CV̲X roots there are also two perfective stems for CV̲(R) roots. The first is the *basic*

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[44] The label *durative* is used here to refer to the primary aspect of active verb themes which are characterized by the perfective type prefix PPA *G-, PA *ɣ̇-. This may be illustrated in the case of the above stem by PA *(t'ə-)də'e·n 'is doing (so)', pf. *(t'ə-)ɣ̇ədə'e·n', (-də-'e·n(') often contracting to -t'e·n(')), cf. also Kari 1979:3.3.3.1.1. For other terminology used in the paper see note 27.

[45] As with CV̲X roots, Ahtna and Tanaina have "expanded" customary stems of invariable *CV(·R)' stem sets (see note 33). These are not to be confused with glottalized lengthened stems.

perfective (B-Ỹ) stem, with the suffix *-Ỹ, represented by the momentaneous and continuative perfective, and the neuter (stative) stem (PPA *'e·n-Ỹ, PA *'e·n). As in the perfectives of CV̲X roots, the perfective suffix *-Ỹ had dropped by PA times following CV̲R roots. Hence this suffix is overtly attested only with open (CV) roots as PA *-ỹ.

In languages which have special negative forms (characterized by the prefixes *s- in the non-perfective and *ỉ·- in the perfective, and the negative enclitic *+he·), the negative neuter stem of open roots is formed by dropping the suffix -Ỹ and adding the enclitic *+he·.[46] Because of the fact that this enclitic begins with a member of the glottal series, the vowel of the stem is shortened in PA (see 1.1). Thus for example compare PPA *'a·-Ỹ 'classif. compact object' (neuter), PA *'a·ỹ, Car. 'ai, Kut. 'áį·, Koy. 'oN, Ing. 'oN, Aht, 'a·n; and PPA *'a·+he· (neg. neuter), PA *'ahe·, Car. 'əh (? Morice ·erh which looks like ['əx̣], but according to Story (1978:128) Babine has final h~', and Carrier has h~0, so that in modern Carrier this stem should be 'ah~'a), Koy. 'o'á, Ing. 'ə', Aht. 'ah (Mentasta 'ahe).[47]

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[46] Also attested as +'e· in some languages in negative perfective forms.

[47] Note, however, that although the perfective suffix *-Ỹ is deleted preceding the enclitic *+he· in negative neuter stems of open roots, (see 4.3), the corresponding stem of CV̲X roots is not spirantized (as is to be expected if the sūffix *-Ỹ were deleted preceding *+he·). For example, compare PPA ni'g-Ỹ+he· 'move hand' neg. neut. pf., PA *nỉ·ĝe·, Koy. nigá, Aẖt. ni·ge, not PA **nỉ·ɣ̂e·. My hypothesis is that the suffix *-Ỹ was in fact deleted preceding the negative enclitic *+he· in PPA, but that the negative neuter stem was not spirantized in PA by analogy with the positive neuter stem. Similarly, analogy may account for the fact that stems which are spirantized in the absence of this enclitic are also spirantized in its presence. This observation applies as well to the possessive suffix *-ə', except for a few fossilized cases mentioned in note 22.

The second perfective stem is identical with the L' stem, and is called the *lengthened perfective* (L'-Ỹ) stem, represented by the durative and neuter (stative) perfective stems (PPA, PA *'e˙n'). It may be that this stem was originally followed by the perfective suffix *-Ỹ, but there is no way to prove this from existing evidence. On the other hand, the suffix *-Ỹ may have had the allomorph Ø following glottal stop, so that the L'-Ỹ stem was formally identical with the L' stem. In this paper, the lengthened perfective stem is reconstructed without the suffix -Ỹ. For the purpose of comparison with CV̲X stem variation, however, it is convenient to have a distinct label for this stem (see 5.2).

There is a third perfective stem, L'-d, attested in Navajo, Carrier, and Alaskan Athabaskan languages as an s-transitional perfective stem. In Navajo alone, this stem is sometimes used as a durative perfective stem; for example, Navajo 'į̀˙d 'do (thus)' perf. occurs alongside 'į́˙' 'see' perf., both from the root *'e˙n. This stem may be classified with the L'-X stem type discussed below.[48]

4.4 Obstruent-suffixed stems

Corresponding to the obstruent-suffixed stems of CV̲X roots are three varieties of obstruent-suffixed stems of CV̲(R) roots: the basic non-glottalized obstruent-suffixed (B-X) stem, represented by the momentaneous repetitive-customary stem B-k (PPA *'en-k, PA *'ɨ·k̲̯ or *'ɨ·x̲̯); the basic glottalized obstruent-suffixed (B'-X) stem, represented by the distributive repetitive-customary stem B'-k (PPA *'en'-k, PA *ɨ̓·k̲̯ or *'ɨ̓·x̲̯; and the lengthened glottalized obstruent-suffixed (L'-X) stem, represented by the durative and neuter (stative) repetitive-customary stems L'-k (PPA *'e·n'-k, PA *'ɨ̓·k̲̯ or *'ɨ̓·x̲̯).[49]

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[48] Another perfective stem formed by suffixing glottal stop to the B-Ỹ stem is attested in various languages. This stem is almost certainly a post-PA or late PA innovation, since its use varies from language to language. In Chipewyan and sometimes in Sarcee, it occurs as a neuter perfective stem (see 4.6.1); in Koyukon and Ingalik it occurs as an inceptive perfective stem; and in Navajo and PCA languages this type of stem may unpredictably occur in place of the B-Y stem, e.g. Navajo bį́˙' 'swim' perf., corresponding to non-glottalized forms elsewhere, and Hupa tšen', Mattole tši˙'n 'make singular' perfective, corresponding to non-glottalized forms outside of PCA.

It should be remarked here that the B'-X and L'-X stems are distinguishable in PA only for ablauting roots. This is because for open roots these stems both appear as PPA *CV'-X > PA *CV̓·X, and for nasal-closed roots PPA *CvN'-X and *CV·N'-X > PA *CV̨̓·X, with identical nasalization whether the root vowel was originally reduced or full. However, with the root *ɬ-ha·y, for example, PPA *ɬ-hay'-X > PA *lẻ·X (B'-X), but PPA *ɬ-ha·y'-X > PA *lả·X (L'-X); see 4.6.5.

Note also that all five productive obstruent suffixes are found with CV̲(R) roots, although *-x is used as a momentaneous imperfective suffix and *-t is an s-transitional perfective suffix, rather than their being semelfactive suffixes as with CV̲X roots.

Stem variation of variable CV̲(R) stems is summarized in the following chart. The PPA form is given first, followed by the PA reflex if phonological changes occur. In the PA forms, Ṽ̲ represents a nasalized or ablauted vowel, and V(˛) represents a nasalized or non-ablauted vowel.

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[49] No L-X roots are found, as is shown by the fact that ablauting roots do not have reflexes of *CV·R before obstruent suffixes. For example, no stem PPA **ɬ-ha·y-ɬ, PA **la·ɬ is attested for *ɬ-ha·y 'classif. pl. obj.' (see 4.6.5).

Table 8. Stem variation of variable CV̲(R) roots.

Stems	Root Types CV	 CvR	 CV·R
non-suffixed			
B	CV·	CvR	CvR
B’	CV’	CvR’ (?)[50]	CvR’,[50]
L	CV·	(missing)	CV·R > CV·(R)[51]
L’	CV’	CV·R’	CV·R’ > CV(·R)’,[51]
perfective			
B-Ỹ	CV·-Ỹ>CV·ỹ[52]	CvR-Ỹ > CvR	CV·R-Ỹ > CV·(R)[51]
L’-Ỹ	CV’	CV·R’	CV·R’ > CV(·R)’,[51]
obstruent-suffixed			
B-X	CV·-X	CvR-X > CṼ·X	CvR-X > CṼ·X
B’-X	CV’-X>CV̓·X	CvR’-X>CṼ̓·X	CvR’-X >CṼ̓·X
L’-X	CV’-X>CV̓·X	CV·R’-X>CV̓(˛)·X	CV·R’-X > CV̓(˛)·X

4.5. Negative and relativizing enclitics

The negative enclitic +he·, as previously mentioned, deletes length from preceding full vowels in PA; PPA *CV·+he· > PA *CVhe· (see data in 4.3 and rule in 1.1). The negative enclitic *+he·

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[50] Distributive (B’) stems are hardly attested outside of Navajo, some Alaskan languages such as Ahtna, Tanaina, Koyukon, and Ingalik, and the Hupa customary stems mentioned in note 38. In most (all?) Alaskan languages, the distributive stem of roots ending in _n_ lacks final glottalization. Final glottalization is found, however, with open and ablauting roots. In Navajo, however, all attested distributive stems of *CV·R roots take final glottalization.

The B’ stem is especially poorly attested for *CvR stems, the stem *wən (4.6.2) being the best attested in my data. Here most languages (all except Hupa?) have merged the B’ (distributive) with the B (continuative) stem.

[51] Final *-n and *-ỹ remain, but *-y and *-w are dropped. See 2.3.4.

[52] Negative neuter perfective PPA *CV·+he· > PA *CVhe·.

and the relativizing enclitics *+yi· (non-human) and *+ỹən (< *+yən ?) (sing. human) (see Thompson to appear) have in common the fact that they lose their initial consonant following a closed stem, and that root-final fricatives not followed by an obstruent suffix become voiced when followed by these enclitics. These fricatives may be original fricatives or spirantized obstruents, e.g. PPA *’a·-ł+he· 'classif. compact obj.' prog. neg., PA *’a·le·, Car. ’al, Koy ’ola, Aht. ’a·le, Tanaina ’ul; also PPA *’a·tš'+he· 'few go' mom. cont. IO > *’ả·š-(h)e· (by spirantization) > PA *’ả·že·, Car. ’az, Koy. ’oza, Aht. ’a·ze.

In the B-X stems of variable CVX roots (i.e., where an obstruent cluster follows a reduced vowel), however, the root-final obstruent remains voiceless even though the obstruent suffix usually drops (see 3.4), e.g. PPA *’atš'-ł+he· 'few go' prog. neg., PA *’ảšłe·, Car. ’əs, Koy. ’ɑsdla, Aht. ’ase, Tanaina ’əš. Likewise, where root-final *t drops before the suffix *-ł in reduced stems, the suffix *-ł does not undergo voicing; e.g. from *ku’t 'take, seize', the negative progressive and negative perfective stem is PPA *k̭ut-ł-(h)e· > *k̭ət-ł-e· > PA *k̭əłe· (not **k̭əle·), Car. tšəł, Koy. kəłá, Aht. kełe, Tanaina kəł. Thus with reduced stems, the rule for voicing intervocalic fricatives is ordered before cluster simplification.

However, in invariable long obstruent-closed stems, where the stem vowel does not reduce, voicing does occur when the obstruent suffix is dropped, even where there was originally an obstruent cluster. Compare, for example, PA *lu·s-ł-e· 'drag' prog., mom. IO neg. (see 5.1.3 for the PPA reconstruction), Aht. lu·ze, Tanaina liz, but Koy. lułdla.

This difference in the voicing of the root-final obstruents of reduced vs. full-voweled CVX stems seems to fit together with the fact that the root-final obstruents of the basic stems of *CvS roots are voiced in PA, whereas voicing does not occur with corresponding long-vowel roots. To get a clearer idea, let us take the pos. and neg. varieties of the B and B-k stems, respectively, of *ỹəł 'pour' and the 'drag' root exemplified above:

	B		B-k	
	pos.	neg.	pos.	neg.
PA	*ỹəl	*ỹəleˑ	*ỹəłk̯̱	*ỹəłĝeˑ
Koy.	nəl	nəla	nəx̯̱tł	nəx̯̱dla
Tanaina	nəl	nəl	nəł	nəł
PA	*luˑs	*luˑzeˑ	*luˑsk̯̱	*luˑsĝeˑ
Koy.	lułl	lula	lux̯̱tł	lux̯̱dla
Tanaina	lis	liz	lis	liz

With Tanaina, the net result is that reduced-vowel fricative-final roots have voiced finals unless obstruent-suffixed (or lengthened), but have voiceless finals when obstruent-suffixed. With full-vowel fricative-final roots, however, the stems without the enclitic are voiceless, but those with the enclitic are voiced, whether or not the stem was originally obstruent-suffixed.

The fact that the voicing rules are different depending on the stem vowel grade appears to cause a problem with respect to rule ordering: voicing occurs before obstruent suffix dropping with reduced-vowel roots, but dropping before voicing with full-vowel roots. Here as elsewhere, however, more data are necessary before a definitive analysis is possible.

The vowels of the enclitics *+(h)e· and *+(y)i· have dropped in many languages, so that their surface manifestation after closed stems is the effect they have on the preceding consonant. Thus these suffixes are often described in terms of light:heavy stem pairs. This is quite similar to what is posited as having happened at an earlier period with the perfective suffix *-Ỹ.

4.6 Examples of variable non-obstruent-closed roots

To illustrate CV̲(R) stem variation, we shall use the roots *'a 'classif. compact object', *wən 'water level moves', *ta·n 'classif. sticklike object', *ha·w 'sing. go', *ł-ha·y 'classif. plural objects' and *x̭a·ỹ 'grow, mature, be(come) aware'. The last two stems illustrate the development of ablauting stems in Athabaskan. (For the unique roots *tš^{w}a·n' 'defecate' and *q'ay' 'spread legs' see 4.1.) To illustrate the lengthened stems, we shall use the forms found in the neuter (stative) stem set, since classificatory stems lack the durative stem set. Only one obstruent-suffixed stem, the rep.-cust. stem, will be used to illustrate the B-X, B'-X, and L'-X variants.

4.6.1. *'a 'classif. compact obj.'

B (cont. impf.) stem: PPA, PA *'a·, Nav. 'á, Chip. 'à, Carrier 'a, Kut. 'é·, Koy. 'o, (in Aht. replaced by the distributive stem), Hupa 'a; cf. Eyak 'ah.

B' (distrib. I(OF) stem): PPA, PA *'a', Nav. 'à', Koy. 'o', Aht. 'a'.

L stem not attested: (Compare the durative impf. stem of *ni 'say': PPA, PA *ni·, Nav. ní, Sar. ní, Chip. nì, Car. ni, Kut. nią́·, (irregular nasalization, **ndía expected) Koy. ni, Aht. ni, Hupa ne.)

L' (neuter opt.) stem: PPA, PA *'a', Chip. 'ą́ (reshaped stem, see note 47), Car. 'a', Kut. 'è', Koy. 'o', Aht. 'a', Hupa 'a' (transitional).

B-Ỹ (mom., cont. perf.; neuter) stem:[53] PPA *'a·-Ỹ, PA *a·ỹ, Nav. 'ą́, Sarcee 'ó(n-), Chip. 'ą̀, Car. 'ai, Kut. 'áį·, Koy. 'oN, Aht. 'a·n, Hupa 'an; cf. Eyak perf. 'ah-ł.

L'-Ỹ (neuter perf.) stem: PPA, PA *'a', Sarcee 'ò̄n (reshaped stem, see note 47)[54], Chip. 'ą́ (reshaped stem), Car. 'a', Kut. 'è', Koy. 'a', Aht. 'a', Hupa 'a'.

B-X (mom. rep.-cust.) stem: PPA *'a·-k, PA *'a·k̯ or *'a·x̯, Nav. 'á·h, Sar. 'ōtš̌ [ó], Chip. 'àih, Car. 'aih, Kut. 'ák, Koy. 'ox̯~'ok, Aht. 'a·s; Eyak 'a·k.

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[53] For the negative neuter (stative) perfective stem see 4.3.

[54] But cf. Sarcee kò̄', not *kò̄n, corresponding with stative perfective kó(n-) 'classif. object in vessel'.

B'-X (distr. rep.-cust.) stem: PPA *'a'-k, PA *'ảˑk̯ or *'ảˑx̯, Nav. 'ā̀ˑh, Koy. 'ox̯~'ok, (Aht. 'aˑ', expanded rep.-cust. stem, found only in Aht. and Tanaina).

L'-X (neuter rep.-cust.) stem: PPA *'a'-k, PA *'ảˑk̯ or *'ảˑx̯, Car. 'aih, Kut. 'ā̀k, Koy. 'ox̯~'ok, Aht. 'aˑx̣ (with rep.-cust. suffix -x̣).

4.6.2 *wən 'water level moves'

B (cont. I(OF)) stem: PPA, PA *wən, Car. bən, Koy. bəN.

B' (distr. I(OF)) stem: PPA, PA *wən' (glottalized?), Car. bən, Koy. bəN, Aht. ben, Ing. vəN~vən' (? latter form given as rep.-cust. stem).

L stem not attested with *Cvn roots.

L' (neuter opt.) stem: PPA, PA *wiˑn', Koy. bin', Mattole biŋ'.

B-Ÿ̆ (mom., cont. perf. neuter) stem: PPA *wən-Ỹ, PA *wən, Nav. bìn, Chip. bə̀n, Car. bən, Koy. bəN, Aht. ben, Hupa mən.

L'-Ỹ (neuter perf.) stem: PPA, PA *wiˑn', Car. bən (irregular), Koy. bin', Mattole biˑ'n.

B-X (mom. rep.-cust.) stem: PPA *wən-k, PA *wɨˑḵ̯ or *wɨˑx̱̯, Nav. bɨ́ˑh, Car. bih, Koy. bix̱̯~bik, Aht. biˑs.

B'-X (distr. rep.-cust.) stem: PPA *wən'-k (glottalized?), PA *wɨ̓ˑḵ̯ or *wɨ̓ˑx̱̯ (?), Car. bih, Koy. bix̱̯~bik, (Aht. biˑn, expanded rep.-cust.)

L'-X (neuter rep.-cust.) stem: PPA *wiˑn'-k, PA *wɨ̓ˑḵ̯ or *wɨ̓ˑx̱̯, Car. bih, Koy. bix̱̯~bik.

4.6.3 *ta·n 'classif. sticklike object'

B (cont. I(OF)) stem: PPA *tan, PA *tən, Nav. tìn, Chip. tə̀n, Car. tən, Kut. tán, Koy. təN, Aht. ten, Hupa tən; cf. Eyak tah, Tl. taˋn.

B' (distr. I(OF)) stem: PPA *tan', PA *tən', Nav. tį̀', Koy. təN , Aht. ten, Ingalik te' (< *tį' ?).

L stem not attested: (Compare dur. impf. stem of *'e·n 'do thus; see', PPA, PA *'e·n, Nav. 'į́, Sar. 'í(n-), Chip. 'į̀, Car. 'en, Kut. 'ín, Koy. 'an, Aht. 'e·n, Hupa 'en; cf. Eyak ʾąh 'see').

L' (neuter opt.; also sometimes mom., cont. opt.) stem: PPA, PA *ta·n', Nav. mom., cont. opt. tą́·', Chip. tą́, Car. tan [tan' ?], Kut. tią̀', Koy. ton', Aht. ta' (not *ta·n': note reshaping of root and cf. Ing. distr. te'), Hupa tan' (trans.).

B-Y̌ (mom., cont. perf., neuter) stem: PPA *ta·n-Ỹ, PA *ta·n, Nav. tą́, Sar. tó(n-), Chip. tą̀, Car. tan, Kut. tín, Koy. toN, Aht. ta·n, Hupa tan; cf. Eyak tah-ł, Tl. tan.

L'-Ỹ̌ (neuter perf.) stem: PPA, PA *ta·n', Sar. tòn, Chip. tą́, Car. tan [tan' ?], Kut. tią̀', Koy. ton', Aht. ta' (reshaped), Hupa tan'.

B-X (mom. rep.-cust.) stem: PPA *tan-k, PA *tį·ḵ̭ or *tį·x̠̭, Nav. tį́·h, Chip. tį̀, Car. tih, Kut. tšík, Koy. tix̠̭~tik, Aht. ti·s; Eyak ta·-k, Tl. tan-k.

B'-X (distr. rep.-cust.) stem: PPA *tan'-k, PA *tį̓·ḵ̭ or *tį̓·x̠̭, Nav. tį̀·h, Car. tih, Koy. tix̠̭~tik, (Aht. ti·n, expanded rep.-cust.).

L'-X (neuter rep.-cust.) stem: PPA *ta·n'-k, PA *tį̓·ḵ̭ or *tį̓·x̠̭, Car. tih, Kut. tšìk, Koy. tix̠̭~tik, Aht. ti·x̣ (with cust. suffix -x̣).

4.6.4 *ha·w 'sg. go'

B (cont. impf.) stem: PPA *haw, PA *ha·, Nav. (ɣ)á, Chip (ɣ)à, Car. (y)a, Kut. (h)é·, Koy. (h)o, Aht. (y)a, Hupa (h)a; cf. Eyak ah.

B' (distr. I(OF)) stem: PPA *haw', PA*ha', Nav. (ɣ)à', Koy. (h)o', Aht. (y)a'.

L stem not attested with CV·w/y roots.

L' (mom., cont. opt.) stem: PPA *ha·w, PA *ha' (ya'[55] after 2s and Ø subject pronoun), Nav. (y)à', Chip. yá, Car. ya', Kut. (h)ì' ~ zì', Koy. (y)o', Aht. ya', Hupa yà'.

B-Ȳ̃ (mom., cont. perf.) stem: PPA*ha·w-Ȳ̃, PA*ya·[55], Nav. yá, Sar. yā ([yá], note irregular vowel), Chip. yà, Car. ya' (cf. Hupa), Kut. z̭í·, Koy. yo, Aht. ya·, Hupa mom. perf. ya (cont. pf. ya', cf. Car.); cf. Eyak perf. (y)ạh-ł.

L'-Ȳ̃ (perf.) stem: Irregularly attested as mom., cont. perf. stem in Car. and cont. perf. in Hupa.

B-X (mom. rep.-cust.) stem: PPA*haw-k, PA*ha·k̭ or*ha·x̭, Nav. (ɣ)á·h, Sar. yátš, Chip. (ɣ)àih, Car. yaih, Kut. (h)ák, Koy. (h)ox̭ ~(h)ok, Aht. (y)a·s, Eyak a·-k.

B'-X (distr. rep.-cust.) stem: PPA*haw'-k, PA*hả·k̭ or*hả·x̭, Nav. (ɣ)à·h, Koy. (h)ox̭ ~(h)ok, (Aht. ya·', expanded rep.-cust.).

L'-X stem not attested (no neuter stem set has been found with this root).

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[55] See Krauss 1969 for explanation of initial *y.

4.6.5 *ł-haˑy 'classif. pl. obj.' (ablauting)

B (mom., cont. impf.) stem: PPA *ł-hay, PA *leˑ, Nav. lé, Sar., Chip. lȁ (reshaped), Car. le, Kut. líˑ, Koy. la, Hupa le; cf. Eyak ł-ah.

B' (distr. I(OF)) stem: PPA *ł-hay', PA *le', Nav. lè', Chip. lɛ́, Koy. la', Aht. le'.

L stem not attested with *CVˑy/w roots.

L' (neuter opt.) stem: PPA *ł-haˑy', PA *la', Chip. lá, Car. la', Kut. lȉ', Koy. lo', Aht. la', Hupa la' (trans.).

B-Ỹ (mom., cont. perf., neuter) stem: PPA *ł-haˑy-Ỹ, PA *laˑ, Nav. lá, Sar. ló, Chip. lȁ, Car. la, Kut. líˑ, Koy. lo, Aht. laˑ, Hupa la; cf. Eyak perf. ł-ah-ł.

L'-Ỹ (neuter perf.) stem: PPA *ł-haˑy', PA *la', Sar. lȍ', Chip. lá, Car. la', Kut. lȉ', Koy. lo', Aht. la', Hupa la'.

B-X (mom. rep.-cust.) stem: PPA *ł-hay-k, PA *leˑk̯ or *leˑx̯, Nav. léˑh, Sar. lótš̌ (reshaped), Chip. lȉ, Car. lih, Kut. lík, Koy. lax̯~lak, Aht. leˑs, Eyak ł-aˑ-k.

B'-X (distr. rep.-cust.) stem: PPA *ł-hay'-k, PA *lė̀ˑk̯ or *lė̀ˑx̯, Nav. lèˑh, Chip. lí, Koy. lax̯~lak, (Aht. liˑ', expanded rep.-cust.).

L'-X (neuter rep.-cust.) stem: PPA *ł-haˑy'-k, PA *lå̀ˑk̯ or *låˑx̯, Car. laih, Kut. lȉk, Koy. lox̯~lok, Aht. laˑx̣ (with suffix -x̣).

4.6.6 *xa·ỹ 'grow, mature, be(come) aware' (ablauting)

B (conclusive[56] impf.) stem: PPA *xaỹ, PA *ɣ̂e·, Nav. ɣé, Sar. ɣá 'grow'; cf. Eyak xah.

B' (distr. I(OF)) stem: PPA *xaỹ', PA *ɣ̂e', Nav. ɣè', Koy. ya', Aht. ye'.

L stem not attested

L' (neuter opt.) stem: PPA *xa·ỹ', PA *ɣ̂a·ỹ', Car. ya [ya' ?] 'be aware' alongside yan [yan' ?] 'be wise', Kut. z̯ɨ̀', Koy. yo', Aht. ya', Hupa yan' (trans.) (see note 19 for Car., Koy., Aht. forms).

B-Ỹ conclusive[56] perf., neuter) stem: PPA *xa·ỹ-Ỹ, PA *ɣ̂a·ỹ, Nav. yą́, Sar. ɣá(n-) 'grow' but yá(n-) 'be wise', Chip. yą̀, Car. yai 'grow, be aware' alongside yan 'be wise'[57], Kut. z̯ɨ́·, Koy. yoN, Aht. ya·n, Hupa yan; cf. Eyak xah-.

L'-Ỹ (neuter perf.) stem: PPA *xa·ỹ', PA *ɣ̂a·ỹ', Sar. yà̃n 'be wise', Chip. yą́, Car. ya [ya' ?] 'be aware' but yan [yan' ?] 'be wise', Kut. z̯ɨ̀', Koy. yo', Aht. ya', Hupa yan'.

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[56] The label conclusive is here used to refer to the primary aspect of active verb themes which are characterized by the perfective type prefix *s-. There are a variety of conclusive stem sets, some having no suffix with the I(OF) stem, and some being suffixed (reversative, rep.-cust.) stems. This root is attested with both B and B-x̣ I(OF) stems. Note also that the Chip. form yɛ̃̀ may be either the B or the B-x̣ stem, since final *x̣ > 0 in Chip. See also Kari 1979:3.3.4.

[57] Note that Carrier has two distinct neuter roots, the expected form yai < *ɣ̂a·ỹ 'be aware', and yan 'be wise', as if from *ɣ̂a·n. These may be reflexes of distinct PA roots which have merged elsewhere, or else yan 'be wise' may be borrowed from another language, since final *y > i in Carrier.

B-X (x̣-suffixed conclusive[56] I(OF)) stem: PPA *xaỹ-x̣, PA *ɣ̂eˑx̣, Chip. yɛ̀ , Car. yeh, Kut. z̭ɨ́ˑ, Koy. yax̣, Aht. yeˑx̣, Hupa yəw; cf. Eyak rep. xaˑ-k.

B'-X (distrib. rep.-cust.) stem: PPA *xaỹ'-k, PA *ɣ̂ẻˑk̯ or *ɣ̂ẻˑx̭, Nav. ɣèˑh, Koy. yax̭~yak, (Aht. yiˑ', expanded rep.-cust.).

L'-X (neuter rep.-cust.) stem: PPA *xaˑỹ'-k, PA *ɣ̂ą̉ˑk̯ or *ɣ̂ą̉ˑx̭, Nav. yą̀ˑh (transitional), Car. yaih 'be aware' but yih 'be old', Kut. zìk, Koy. yox̭~yok, Aht. yaˑx̣ (with suffix -x̣).

4.7 Comparison of PPA, Eyak, and Tlingit open stem variation

A thorough comparison of Eyak and Tlingit open stem variation with Athabaskan CV̲(R) stem variation is not within the scope of this sketch. It should be noted, however, that sonorant-closed roots group with closed roots in Tlingit, and that Eyak lacks a distinct class of sonorant-closed roots. This discussion will therefore be confined to open roots.

Both Eyak and Tlingit have two perfective stem types for variable open roots. In Eyak the first is CVh-ɬ and the second CV'-ɬ. It may be that the perfective suffix -ɬ is an innovation in Eyak, in which case CVh would correspond to the Athabaskan B-Ỹ stem and CV' to the L'-Ỹ stem. The non-glottalized stem is exemplified by the Eyak s-perfective sətehɬ 'is lying', PPA stative neuter *site˙Ỹ, PA *səte˙ỹ; the glottalized perfective stem by Eyak səɬe'ɬ 'became', PPA *Gəỹiɬe'> PA *ɣ̉əỹle' 'was', transitional PPA *səɬe'(t), PA *səle' or *səlẻ˙t 'became'. The Tlingit positive perfective stems are characterized by the suffix /-y̲/[58] for the first type (Ø-conjugation perfective), corresponding to Athabaskan -Ỹ, and a fading vowel nucleus for the second type (non-Ø-conjugation perfective), possibly corresponding to the Athabaskan L' stem.

In both Eyak and Tlingit, not all suffixes join with stems in the same way; in general, however, there are two stem types which occur with a given suffix in both languages. In Eyak, stems of the first type occur as CV˙- preceding the suffixes

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[58] This suffix is a morphophoneme, not occurring overtly in the perfective stem. Its presence is adduced by a comparison of stem forms which can only be mentioned here.

-ł (prog.), -k (rep.), -x̣, corresponding to the Athabaskan B-X stem type; stems of the second type occur as CV'- preceding these suffixes, corresponding to the Athabaskan L'-X stem type. Thus, for the above roots, compare the Eyak progressive forms Gəte·ł 'is moving in lying position', PPA *Gəte·ł, PA *ɣəte·ł, with Eyak Gəłe'ł 'is becoming', PPA *Gəłe'ł, PA *ɣ̇əlè·ł.

In Tongass Tlingit, the two stem types are CV·- (lengthened) and CVˋ- (fading), with ablaut, preceding obstruent suffixes. These are not conjugation-related as in the case of the perfective stem: each open root is marked as to which of the two suffixed stem types it takes. It is possible, however, that the fading stem type is related to the Eyak glottalized stem type and the Athabaskan L'(-X) stem. Compare, for example, Tongass Tlingit wuˋ-niˋ 'became (thus)', and the progressives y̲a̲ˋ naniˋn 'is becoming (thus)', y̲a̲ˋ na-te·n 'is moving in lying position', with the above examples.

Table 9. Tentative comparison of PPA, Eyak and Tlingit open stem variants.

	PPA	Eyak	Tlingit
perfectives	*CV·-Ỹ	CVh-ł	CV· < *CV·-y̲
	*CV'	CV'-ł	CVˋ
obstruent-suffixed stems	*CV·-X	CV·-X	? CV·-X
	*CV'-X	CV'-X	? CVˋ-X

5. Overview

5.1 PPA root types

5.1.1 Variable root types

Thus far the following variable root types have been reconstructed for PPA:

CV̱(R): *CV, *CvR, *CV·R (rarely also *CvR' and *CV·R')
CV̱X: *CvX, *CV·X, *CV'X

5.1.2 Invariable root types

Besides these, there are a relatively small number of roots that can be reconstructed as invariable roots for (P)PA, falling into three categories. The first category is that of onomatopoetic roots, which tend to be fully invariable, especially in Alaskan languages and Carrier. The second category is that of denominal roots, which are often treated as invariable in some languages and variable in others. Finally, there are a very few verbal roots of the shape *CV̱(R)' which have no special basic or lengthened stems, and thus can be classified as invariable roots (at least in PPA). The last two categories, denominal roots and *CV̱(R)' roots, may take obstruent suffixes, but they do not undergo reduction of the stem vowel; note that *tša· does not take the perfective suffix *-Y̌̃. In the second category we find roots of the shapes *CV·, *CV', *CvR, *CV·R', as well as CV̱X roots.

*tša· 'cache', (from *tša· 'cache', concl. PfIOF *tša·, Chip. tsà, Car. tsa (OF -ł), Kut. tsí·, Koy. tso, Aht. tsa· (The rep.-cust. stem of this root is PA *tša·k̯ or *tša·x̯, Chip. tsàih, Car. tsaih, Koy. tsox̯, Aht. tsa·x̣ (with -x̣ as rep.-cust. suffix)).

*q'e' 'cool', concl. PfIOF *q'e', Nav. k'è' (F. -ł), Kut. k'ì', Koy. q'a', Aht. q'e', Eyak q'e'.

*wən' 'build (menstrual) hut', (from *wən' 'menstrual hut'), concl. PfIOF *wən', Nav. bìn' (f. -ł), Car. bən [bən' ?], Hupa men', Mattole biŋ'.

*t'a· and *t'a·n' (from PA *t'a· 'feather' and t'a·n' 'leaf') 'feather arrow', Chip. t'àl (< t'a·-ł), Sar. pf. t'ó(n-), IO t'íh, Koy., Ing. t'on', Mattole t'a· (F -ł), cf. Eyak t'ahł 'feather, leaf', Tl. t'aˋw 'feather'.

*šu·k 'comb, brush', prog. (also neg. perf.), PPA *šu·k-ł, PA *šu·x̬ł, Nav. žòh (reduced), Car. dzuh (neg. pf.), Kut. pf. ž^{r}ùk, IOF ž^{r}úk, Koy. zux̭dla (neg. pf.), Aht. zu·s (mom. fut.), Hupa tšoĝ (invar.), Mattole tšo·xw (invar.).

Note that in Navaho the last root is treated as variable, that is, the obstruent-suffixed stems are reduced. In most cases with CV̲X roots, we find that a denominal root treated as invariable in one or more languages is variable in others. In any case, it should be noted that for roots of the shape CV̲X and CV̲(R) (but not *CV(R)'), variable roots are the norm and invariable roots the exception, the latter being in virtually all cases onomatopoetic or denominal. In contrast, glottal-stop-final roots are almost always invariable (see also 4).

5.1.3 Broken roots

Belonging to a separate category are a few irregular roots which were probably originally *CV̲RV̲X roots:

PPA *həwəs (?), PA *hu·s 'stretch, pull', *də-hu·s > *du·s 'crawl, pull self', *ł-hu·s > *lu·s 'drag, stretch, pull', prog. and mom. fut. *lu·sł, Nav. ló·s, Chip. lũ̀θ, Car. lus, Kut. lil (< *lúθtł), Koy. lułtł, Aht. lu·s, Hupa losəł, Mattole lo·s; cf. Eyak wəs 'stretch'.

PPA *haya'ts (?) 'singe', PA Pf. *hả·ts, IO *he·s, Nav. zẽ̀·z/zé·s (Pf/IO), Chip. ðáð/ðã̀θ, passive neut. dáð, Kut. hið̃·/hiá·, Aht. ya·ts/ye·s, passive neut. da·ts, Hupa ł-das (< causative of passive neut.); cf. Tlingit hits 'singe'

PPA *kaya'tš (?) 'render fat, make broth', PA Pf. *k̯ả·tš, IO *k̯e·š, Chip. tšáz/tšɛ̃̀s, Koy. kots/kots, Aht. ka·ts/ke·s, Tanaina kutš/kaš; cf. Eyak ka·tš 'stew'.

Broken roots such as the above were probably originally more numerous, although they are hard to reconstruct, due to sketchy data and analogical developments. Especially interesting are the broken roots found in Ingalik and Tanaina, such as Ingalik ž^{r}əŋətł 'bail', gəŋəš^{r} 'tickle', ts'əmətł 'swing' and Tanaina džəməq' 'plunk', and compare Ingalik dzəɣətł 'play', Tanaina (Lime) džəɣətł' 'play catch'. The Ingalik root gəməθ 'roll' even has a lengthened mom. IO stem geməθ. Note also Lower Koyukon ts'ayəx̯tł 'swing' and zəɣətł 'bail', and Tanana ḍzəɣət 'tickle'.[59]

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[59] Other survivals of PA broken roots are found in stems which are nasalized in Alaskan languages such as Mentasta Ahtna, Tanacross, Upper Tanana, Han, and sometimes Kutchin. In these languages, original PA nasalization is not attested: compare for example PPA *tən-ł 'classif. sticklike obj.' prog., PA tį·ł, Mentasta ti·ł, Tanacross tĩ̀·ł, Upper Tanana ti·ł, Han tšew, Kutchin tšiá·. PA *CvNvX(X), however, may result in a nasalized vowel in these languages, cf. Ing. təŋəł 'pail', Tanacross, Upper Tanana tu-tį·ł (< tu·- 'water'), Kutchin tšu·n-tįáh; cf. also Ing. gəŋəš^{r} 'tickle', Han džõ̀r-

5.1.4 *CvXX roots

A small number of anomalous roots appear to be survivals of a class of roots which ended in obstruent clusters (*CvXX). These are unique not only in the alternation of stem-final consonants (in the first two roots given below), but also in that the perfective stems end in voiceless fricatives. The fact that these fricatives are not voiced suggests that they were protected from the perfective suffix *-Ỹ by an intervening obstruent.

PPA *'ax̣t (?) 'handle fabric quickly', PA mom. Pf. *'ɑx̣, IO *'a·t, Nav. 'ȁh/'á·d, Sar. 'ȍ'/'ó' (*-t), Chip. 'ȁr/'ȁr, Car. 'əx̣/'at, Kut. 'at/'at, Koy. 'ɑx̣/'ot, Aht. 'at/'a·t, Hupa 'ɑd; cf. Tlingit 'ax̣ 'classificatory fabric'.[60]

PPA *tłax̣t (?) 'run, jump up, ignite suddenly', PA mom. Pf. *tłɑx̣ or *tłɑx̣^{w} (?), IO *tła·t, Nav. tłȁh/tłá·t, Sar. tłōh~tłōt/tłó(d-), Chip. tłȁ/tłá(r), Car. tłəx̣/tłat, Kut. tłé·/tłít, Koy. tłʋx̣/tłot (irregular ʋ), Aht. tłet/tła·t, Hupa ład; cf. Eyak ƛe'x̣ 'flop'.

PPA *k^{W}asX (??) 'whip, act quickly with rope-like object', PA mom. Pf. *tš^{W}ɑs, IO *tš^{W}a·s, Nav. tsȁs/tsá·s (but fut. and cust. tsȉs), Sar. tsōs/tsós (cf. tsíst [ī] 'make whizzing sound', tsísdí [ī] 'make crackling sound (of whip)'), Chip. tθȁθ/tθȁθ, cf. tθȁiθ 'a whip', Car. tsəs/tsas, Kut. tš^{r}ȉ·/tš^{r}í·, Koy. tsʋł/tsoł, Ing. troθ/troθ, Aht. tses/tsa·s (? 'choke with line', cf. tsez 'whip', and sem. tses), Hupa tsas.

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[60] Possibly source of, or diffused from source of (Skidegate) Haida 'ax̣ət 'net'.

The fact that these roots all refer to sudden actions suggests that the final obstruent was by origin a thematized suffix.

Koyukon also has several interesting survivals of doubly-closed roots, e.g. gəłtł 'hook' < PA *gə̓s-ł, PPA *gəts'-ł (originally an instrumental noun with the suffix -ł). Note particularly the Koyukon customary stem gəx̱̯tł (< *gə̀s-x̱̯ or *gə̓s-ḵ̯ by metathesis), which appears to indicate that the suffix -ł is replaced by the customary suffix. In other words, there is only one obstruent suffix position. Eyak, on the other hand, permits clusters of at least three obstruent suffixes.

5.1.5 CVy' roots

The description of Cvy' roots (such as *q'ay', see 3.3) and CV·y' roots is complicated by the fact that lengthened non-perfective stems from these roots show PA final *x̱̯. This seems to indicate that already in PA the original sonorant *y was being reinterpreted as an obstruent, i.e. *ɣ̂[61]. In some cases, *y' is even reinterpreted as *ḵ̯', as the following examples show:

PPA *Gay 'be white' (neuter), PA *Gɑy (Outer Tanaina Gəy, see note 9); transitional possibly PPA *Ga·y' (? Hupa Gay' may preserve an old L' stem), PA transitional perf. *Ga̓·y, IO(F) *Ga·x̱̯, Nav. gȁi· [? = gȁ·i]/gá·h, Sar. góy/góy (?), Chip. gái/gȁi, Car. gai/gaih, Kut. gȉ·/gí·, Koy. Gox̱̯/Gox̱̯ Aht. Ga·s/Ga·s, Tanaina Guy/Gux̱̯, Hupa Gay', but note Hagwilgate Babine Gik (J. Kari, personal communication).

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[61] In stems of the type *CV̲y', *y must be a sonorant, since *' is non-canonical after obstruents (see 1.2).

PPA *tsa·y 'be dry' (neuter), transitional *tsa·y', PA transitional *tsa·y'/tsa·x̯, Nav. tsài·/tsá·h, Kutchin kìk (< *tθak̯)/kí·, Koy. tłok/tłox̯, Aht. tsa·k'/tsa·s, Tanaina tsuɣ̂/tsux̯, Hupa tsay' (neuter tsay), Mattole tsai' (neuter tsai). Note the change *y' (> * ɣ̂') > *k̯' in Kut., Koy., and Aht., paralleling Hagwilgate Babine Gik < *Ga·y' above.

5.1.6 *we·k^{w} 'cook (by boiling)'

The root *we·k^{w} 'cook (by boiling)' has the unique property of failing to spirantize in the conclusive IO(F) stem:

PPA *we·k^{w}, PA concl. PfIOF *we·tš^{w}, Nav. bé·ž (fut. *-ł), Sar. máz, and neuter máts 'be cooked', Chip. bɛ̀z, Car. liz but mom. IO lis[62], Kut. vír, Koy. bats but mom. IO bas, Ing. vatr but mom. IO vasr, Ahtna le·ts but mom. IO le·s, Tanaina latš but mom. IO laš, Hupa metš; cf. Eyak wa'k' 'become tender by boiling', Tlingit 'uk 'boil'.

5.1.7 Suppletive roots

In a few cases suppletive stem sets are found. The perfective stem usually is supplied by a suppletive root in these cases, such as PA *yả·G 'become (thus)' perf., suppletive root of IO *ne·x̣ and F *ni·ł from root *ni. In some languages even a suppletive rep.-cust. stem is found, PA *'ɨ̓·k̯ or *'ɨ̓·x̯, the L'-k stem of root *'e·n 'do (thus)', Nav. 'ɨ̀·h, Chip. t'ɨ́ (with d-classifier), Aht. 'i·s.

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[62] The Carrier, Ahtna, and Tanaina forms may be from PPA *ł-we·k^{w}, with dropping of initial *w yielding PA *le·tš^{w}.

5.2 Comparison of PPA CV(R) and CVX verb stem variation

In the following chart the stem variation described for PPA CV(R) and CVX roots is compared.

Table 10. Comparison of PPA CV(R) and CVX verb stem variation.

	CV	CvR	CV·R	CvX	CV·X	CV'X
basic						
B	CV·	CvR	CvR	CvX	CV·X	CV'X
B'	CV'	CvR' (?)	CvR'			
lengthened						
L	CV·	—	CV·R	CV·X	CV·X	CV·X
L'	CV'	CV·R'	CV·R'			
perfective						
B-Ỹ[63]	CV·-Ỹ	CvR-Ỹ	CV·R-Ỹ	CvX-Ỹ	CV·X-Ỹ	CV'X-Ỹ
L'-Ỹ	CV'	CV·R'	CV·R'			
obstruent-suffixed						
B-X	CV·-X	CvR-X	CvR-X	CvX-X	CvX-X	CvX-X
B'-X	CV'-X	CvR'-X (?)	CvR'-X			
L'-X	CV'-X	CV·R'-X	CV·R'-X			

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[63] *-Ỹ dropped in negative neuter imperfective stems.

The following rules summarize the phonological processes posited for PPA verb stem variation with variable roots as seen in the above table:

1. In non-perfective basic stems, *CV·R > *CvR (also *CV·R’ >*CvR’, see 4.1).
2. There are lengthened perfective (L’-Ỹ) stems for CV(R) roots but not for CVX roots. Alternatively, one could say that lengthening is zeroed out preceding *-Ỹ for CVX roots.
3. If lengthening is not prevented by rule 2, then *v, *V’ > *V· in lengthened stems. In CV(R) roots, *ə always lengthens to *i·; in CVX roots, *ə lengthens to *i·, except next to uvulars and in a few exceptional roots (see note 29) where *ə lengthens to e·.
4. *V·, *V’ > *v/__X-X in variable CVX roots.
5. The glottalized variants of the basic stem (B’) and the lengthened stem (L’) are formed by the addition of *’ for CV(R) roots (but see note 49).
6. *-Ỹ > Ø/__+he· in negative neuter stems.

Since each CV(R) stem variant corresponds phonologically to (i.e., maps onto) one and only one CVX stem variant, the abbreviations for CV(R) phonological stem variants can be used as general labels to describe both CV(R) and CVX stem variants. Thus, for example, the label B denotes the B (basic) stem variant for both CV(R) and CVX roots, whereas the label B’ denotes the stem variant B’ (glottalized basic stem) for CV̲(R) roots and B (basic stem) for CV̲X roots. In this way we can take advantage of phonological correspondences between CV̲(R) and CV̲X roots in comparing their stem variation. Note, however, that the general label L̲'̲-̲Ỹ̲ denotes the stem variant L'-Ỹ for CV̲(R) roots (formally identical with the L' stem, as previously remarked), but simply *-Ỹ (= B-Ỹ) for CV̲X roots, since we state that lengthening does not apply to CV̲X perfective stems in rule (7) above. The motive behind this juxtaposition will be seen in the second half of this paper.

5.3 Morphological comparison of stem variation for non-obstruent closed and obstruent-closed roots

It is important for the reader to keep in mind that in modern Athabaskan languages, stems used in a given stem set for CV̲X roots are not always phonologically comparable with those used in the corresponding stem set for CV̲(R) roots. Thus the phonological correspondences given above are n̲o̲t̲ always comparable in their distribution patterns. For example, whereas the momentaneous imperfective and optative stem of CV̲X roots is the lengthened stem, with CV̲(R) roots the momentaneous imperfective is usually formed by the addition of *-x to the B or L' stem, and the momentaneous optative stem is supplied by the B-ł stem, (i.e., same as momentaneous future), e.g. *'a 'classificatory compact object', mom. imperf. PPA *'a'-x > PA *'ả·x̣̭, mom. opt. (P)PA *'a·ł; compare *dəts 'spin ropelike object', mom. IO PPA *di·ts > PA *di·s. A morphological comparison of CV̲(R) and CV̲X aspectual stem variation is therefore necessary to gain a more complete understanding of the origin of verb stem variation as attested in modern Athabaskan languages.

The second half of this paper deals with this issue, and discusses the origin of the characteristic Athabaskan aspectually chosen stem-set system. Note, however, that the historical development to be postulated in the next part of this sketch cannot always be verified by direct comparison within Athabaskan or Na-Dene languages; it is based on the premise that stems from one stem set were sometimes "borrowed" by another stem set, and that obstruent suffixes were sometimes added to CV(R) stems by analogy with other stems. Therefore, some of the historical development to be postulated in the following half of this paper is quite hypothetical; nonetheless, it is to be a preliminary attempt to explain the development of the tense-mode-aspect system of Athabaskan in a way that also shows its relationship to that found in Eyak and Tlingit.

Appendix:

List of major phonological rules

Following is a compilation of the most important rules discussed in this paper regarding the transition from PPA to PA verb stem phonology (exclusive of changes in the verb stem initial). The rules for stem variation posited as already operative in PPA have been listed in section 5.2; the following rules operate on the forms generated by those rules. Each rule or subrule is labeled as to where it is discussed in the paper.

The order of the rules listed below is not meant to imply a historical sequence of events in all cases. In particular, it seems most likely that rules A-D occurred simultaneously over a relatively short period in the history of Athabaskan. For example, in a case like PPA *tən'-ł-(h)e· it does not matter particularly whether we present the rules in the sequence given, *tən'le· > tɨ··'łe·> tɨ̓·łe·> tɨ̓·le·, or in the reverse order (modifying the rules) *tən'łe·> tən'le· > tə̀nle·> tɨ̓·le·. We have here chosen to order the rules in order of proximity to the stem vowel. This creation of what are probably unhistorical ordered rules creates a theoretical difficulty. Strictly, although we can say that PPA *tən'łe· > PA *tɨ̓·le· without fear of being too far off, it would seem wrong to state that an intermediate step like *tən'łe· > *tɨ"łe· was a historical reality. We nevertheless use wedges in these rules, with the understanding that the wedges do not necessarily imply historical reality with regard to the intermediate stages of a form.

With other rules, however, it seems likely that the ordering is based on historical sequence; for example, rule E.1 (Ỹ-deletion) must be subsequent to rules C (spirantization) and D.2 (voicing), since the presence of the perfective suffix determines the outcome of these rules. Likewise, rule F.1 must follow rule E.1 in a case like *ha·w-Ỹ > *ha·w > *ha·; if the order were the reverse, the outcome would be *ha·ỹ, which is precisely what we sought to avoid by postulating PPA final *w.

Note also in regard to rule F that an interesting phonetic problem has, according to the rules, arisen and then been resolved. If we assume that a form like PPA *qe·w'-x̣ (from (*qe·w 'pl. sit') > *qẻ·^{w}x̣ previous to the operation of F.1, and on the other hand a form like PPA *tłe·q'^{w} (from *tłe·q'^{w} 'classif. doughlike mass') > *tłẻ·x̣^{w} previous to F.2., then it is hard to imagine that these two forms did not rhyme at this intermediate stage. The resolution of this phonetic indeterminacy is accomplished by neutralizing the coloration postulated at the end of the syllable. This is why these two phenomena are grouped under the same rule.

The order of rule H is quite arbitrary, since the final outcome of a given form would not be changed no matter where this rule applied. Note that rules F.2 and H.2 describe the loss of phonemically labialized uvulars and labialized *'. Finally, rule I (t-dropping) is placed last because it is the only cluster simplification rule which can be attributed to PA, all others being post-PA.

The symbol + here denotes an enclitic boundary and # a word boundary.

A. Sonorant diffusion

1. Ablaut (2.3.4)

$vR > v^{R.}$ in the fg. combinations:

vR	v^{R}	
aw	a	
ay aỹ	e	/except following a uvular
əw	u	
	and probably also	
əy	i	(see note 26)

2. Non-nasal sonorant diphthongization (2.3.4)

$V{\cdot}R > V{\cdot}^{R}/\_\_’$, where R is y, w.

3. Nasalization(2.3.3)

V̲N > V̨·/__X

in the fg. combinations:

V̲N	V̨
i·n	ɨ
i·ỹ	
e·n	
e·ỹ	
ən	
əỹ	
u·n	ų
u·ỹ	
a(·)n	ɨ/ not fg. a uvular ą/ fg. a uvular
a·ỹ	ɨ/ not fg. a uvular in active stem sets ą/ fg. a uvular or in neuter stem sets
aỹ	ą/ fg. a uvular or in neuter stem sets

Note that *ay and *aỹ are not affected by ablaut following a uvular, and that *aỹ may be affected by nasalization following a uvular. Combinations of vowel plus sonorant not treated here are either not found in reconstructions, such as *uy, or problematic, such as *un, which cannot be proven to have existed, since modern Athabaskan ʋn may reflect original *əw̃. With verbs, cases of final *w̃ are reconstructible only rarely for invariable roots, and are not treated here.

B. Glottal diffusion (constriction not associated with spirantization, 2.3.2)

1. $V(\cdot)ː > \overset{ʔ}{V}\cdot/\_\_X$, where $V(\cdot)$ includes diphthongized and nasalized vowels, from rule A.

2. $v > \overset{ʔ}{v}/\_\_T'$

C. Spirantization (including associated constriction, 2.3.1)

1. with non-glottalized final

$$\left.\begin{array}{lllll} \text{a.} & V\cdot X^{-} & > & V\cdot S/\_\_\begin{Bmatrix}\#\\+\end{Bmatrix} \\ \text{b.} & \underline{V}X^{-} & > & \underline{V}S/\_\_X \end{array}\right\},$$

where if $X^{-} = t$, $S = t$.

Constriction produced by B.1 is retained.

2. with glottalized final

$$\left.\begin{array}{lllll} \text{a.} & V\cdot X' & > & \overset{,}{V}\cdot S/\_\_\begin{Bmatrix}\#\\+\end{Bmatrix} \\ \text{b.} & \underline{V}X' & > & \overset{,}{\underline{V}}S/\_\_X \end{array}\right\},$$

where if $X' = t'$, $S = t$

D. Voicing (1.3.3)

1. $S > Z/\_\_\begin{Bmatrix}-\tilde{Y}\\+V\end{Bmatrix}$

2. $S > Z/v\_\_\begin{Bmatrix}\#\\+\end{Bmatrix}$

E. $\tilde{Y}$-adjustment (3.1)

1. $-\tilde{Y} > \emptyset/C\_\_$

2. $-\tilde{Y} > \tilde{y}/V\_\_$

F. Loss of coloration with full vowels

1. Non-nasal sonorant dropping (2.3.4)

$$\left.\begin{array}{ll} \text{a.} & V^{\cdot R'} > V' \\ \text{b.} & \left.\begin{array}{l} V^{\cdot R} \\ V^{\cdot}R \end{array}\right\} > V^{\cdot} \end{array}\right\} \text{, where R is y, w.}$$

2. Loss of phonemic labialization (1.3.1)

$$X^{w} > X/V^{\cdot}$$

G. Vowel shortening (4.5, cf. also F.1.a. above)

$$V^{\cdot} > V/\_\_+he^{\cdot}$$

H. Development of reduced vowels

(other than by sonorant diffusion, A.1)

1. $\begin{vmatrix} a \\ u \end{vmatrix} > \begin{vmatrix} \text{ɑ} \\ \text{ʊ} \end{vmatrix}$ (1.3)

2. $\left\{\begin{array}{l} \text{ə} \\ \text{ɑ} \end{array}\right\} > \text{ʊ}/X^{w}$, and $X^{w} > = X$
   where X is a uvular or ʼ (1.3.1)

3. $\text{ʊ} > \text{ə}/\underline{\check{G}}\,\_\_$ with some roots, unpredictably (1.3.2)

4. $\text{ɑ} > \text{ə}/C\_\_n$ in reduced basic stems (4.1)

I. t-dropping (3.4)

$$t > \emptyset\_\_/\left\{\begin{array}{l} -\text{ł} \\ -\underset{\frown}{\underline{k}} \end{array}\right\}$$

Other rules which are widespread in Athabaskan have too much variation among the daughter languages to be ascribed to PA per se. In particular, among the cluster simplification rules, only t-dropping (I) is universal enough to be ascribed to PA, and even here there are exceptions (e.g. tk̭ > Aht., Tanaina t, in Ahtna probably due to the fact that the rep.-cust. suffix never does appear on the surface as -k̭). Other cluster simplifications are discussed in 3.4. A brief historical discussion of the enclitics is found in 4.5. Other than the above, most of the important material relating to the reflexes of PA forms in the daughter languages is included in 1.2.

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